# ANNUAL FORECAST VERIFICATION STATISTICS

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Met Office

## Introduction

This collection of tables and figures contains series of statistics compiled from the results of routine verification over many years. Some of the statistics have been obtained by verifying the products of the numerical weather prediction model in operational use at the time: others have come from the verification of forecasts made by the staff of the National Meteorological Centre (NMC) formerly Central Forecasting Office (CFO), and the outstations.

A brief summary of the NWP models used operationally in the Met Office is given below:

| | |
|---|---|
| Nov 1965-Jul. 1972 | 3-level Model |
| Aug 1972-Aug. 1982 | 10-level Model ('Octagon' and 'Rectangle'} |
| Sep 1982-May 1991 | 15-level Model ('Coarse-Mesh' and 'Fine-Mesh'} |
| Jun 1991- | Unified Model ('Global' and 'Limited Area') |
| Dec 1992- | Unified Model ('Mesoscale') |
| Jan 1998- | High resolution version of Global model implemented. |
| Apr 1998- | High resolution Prelim Global model replaced the Limited Area model. |
| Jun 1998- | High resolution version of Mesoscale model implemented. |

The following areas have been used for verification:

| | |
|---|---|
| Northern Hemisphere | 90°N - 30°N |
| Tropics | 30°N - 30°S |
| Southern Hemisphere | 30°S - 90°S |
| Area 2 | W.Canada to Europe (See Figure 1) |
| 48-points | U.K. (see Figure 2) |

## The Tables

Results from verification involving only computer-generated forecasts are presented in Tables 1 to 9. In Table 10 the hand-drawn analyses in NMC have been used to verify both machine and man-made forecasts. Verification results from the wave prediction models are presented in Tables 11 and 12. Table 13 gives results of the London precipitation verification scheme.

Throughout the tables results are given in units of metres (heights and wave heights), hPa (pmsl), knots (winds) and seconds (wave periods). Persistence errors are preceded by a solidus "/". The use of asterisks indicates missing data. The terms 'Global' and 'Limited Area' are used generically to indicate the resolution of the model in use at the time.

The verification statistics presented in Table 1 have been derived using the best available observations, either radiosondes for the upper-air or synops and ships for the surface, while those in Tables 2 to 5 are based on comparisons with model analyses.

Table 6 presents verification of precipitation forecasts from the Limited Area Model against selected reporting stations in the UK for the past year.
Table 7 gives verification scores calculated from these results back to 1988.
Please note that from 1998 the Limited Area precipitation verification is for the 06Z Forecast run only, giving a direct comparison with the corresponding Mesoscale results. Also, from 1998, only the UK area results are presented, up to T+30.

Table 8 presents verification of precipitation forecasts from the Mesoscale Model for the past year. Table 9 gives verification scores back to 1993 calculated from these results, and other verification statistics derived using surface observations.

Table 10 presents verification of NMC and model forecasts for the 6x8 array of points shown in Figure 2. This array is a legacy from the original grid of the 3-level model (see, for example, Meteorological Office Scientific Paper No 9) and the verification of the NMC forecast by this scheme (Table 10(a)) provides the longest run of verification statistics, back to 1957. Heights at 1000hPa and the implied geostrophic winds are verified against values extracted from the hand-drawn analyses in NMC.

Tables 11 and 12 present results from verification of the Global and European Wave Models respectively. The results given are averages over all observing stations. Wave height and wave period statistics are given. Forecasts of wind speed from the NWP models are used to drive the wave models, and so verification of wind speed is also given.

Table 13 summarizes the performance of NMC's forecast of whether measurable precipitation will fall in London the next day. Model results since 1984 are also presented.

A summary of the tables is given below:


| | | |
|---|---|---|
| Table 1 GM verification against observations - | Area 2 | (1978-2000) (Page 4) |
| Table 2 GM verification against analyses - | Area 2 | (1967-2000) (Page 7) |
| Table 3 GM verification against analyses - | N.H. | (1984 -2000) (Page10) |
| Table 4 GM verification against analyses - | Tropics | (1984 -2000) (Page13) |
| Table 5 GM verification against analyses - | S.H. | (1984 -2000) (Page14) |
| Table 6 LAM rainfall verification - tables | | (2000) (Page17) |
| Table 7 LAM rainfall verification - scores | | (1988 -2000) (Page18) |
| Table 8 MESM rainfall verification | | (2000) (Page19) |
| Table 9 MESM verification against observations | | (1993 -2000) (Page20) |
| Table 10 GM, LAM and NMC 48-point scheme | | (1957 -2000) (Page22) |
| Table 11 Global Wave Model verification | | (1988 -2000) (Page27) |
| Table 12 European Wave Model verification | | (1988 -2000) (Page28) |
| Table 13 LAM and NMC London precipitation | | (1962-2000) (Page29) |


(GM refers to Global Model, LAM to Limited Area Model, MESM to Mesoscale Model)

The Figures

A selection of the statistics given in the tables is also presented graphically in the form of time-series. A summary is given below:


Figure 3 Verification against observations - Area 2 (Page31)
- a) rms error of PMSL
- b) mean error of PMSL

Figure 4 Verification against analyses - Area 2 (Page32)
- a) rms error of 500 hPa geopotential height
- b) mean error of 500 hPa geopotential height

Figure 5 Verification against analyses - Area 2 (Page33)
- a) rms vector wind error at 500 hPa
- b) rms vector wind error at 200 hPa

Figure 6 Verification against analyses - Northern Hemisphere (Page34)
- a) rms error of PMSL
- b) rms vector wind error at 200 hPa

Figure 7 Verification against analyses – Tropics (Page35)
- a) rms vector wind error at 850 hPa
- b) rms vector wind error at 200 hPa

Figure 8 Verification against analyses - Southern Hemisphere (Page36)
- a) rms error of PMSL
- b) rms vector wind error at 200 hPa

Figure 9 48-point verification (NMC v. Global v. Limited Area) (Page37)
- a) rms error of 1000 hPa geopotential height
- b) rms vector wind error at 1000 hPa
- c) 1000 hPa height change correlation
- d) 1000 hPa wind stretch vector correlation

Figure 10 Verification of London Precipitation Forecast (Page39)
- a) Percentage correct of CFO/NMC forecasts
- b) Percentage correct of FM/LAM/PRELIM forecasts

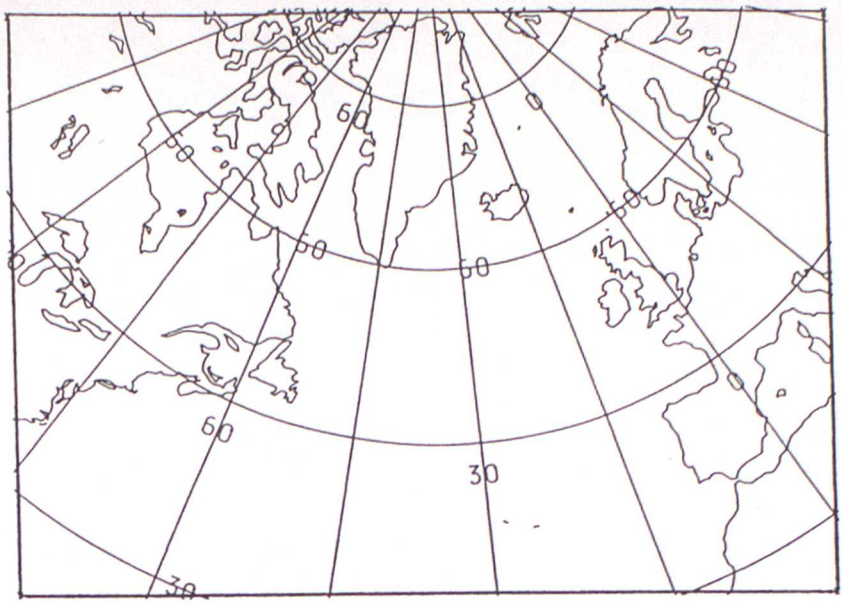


Figure 1. Area 2

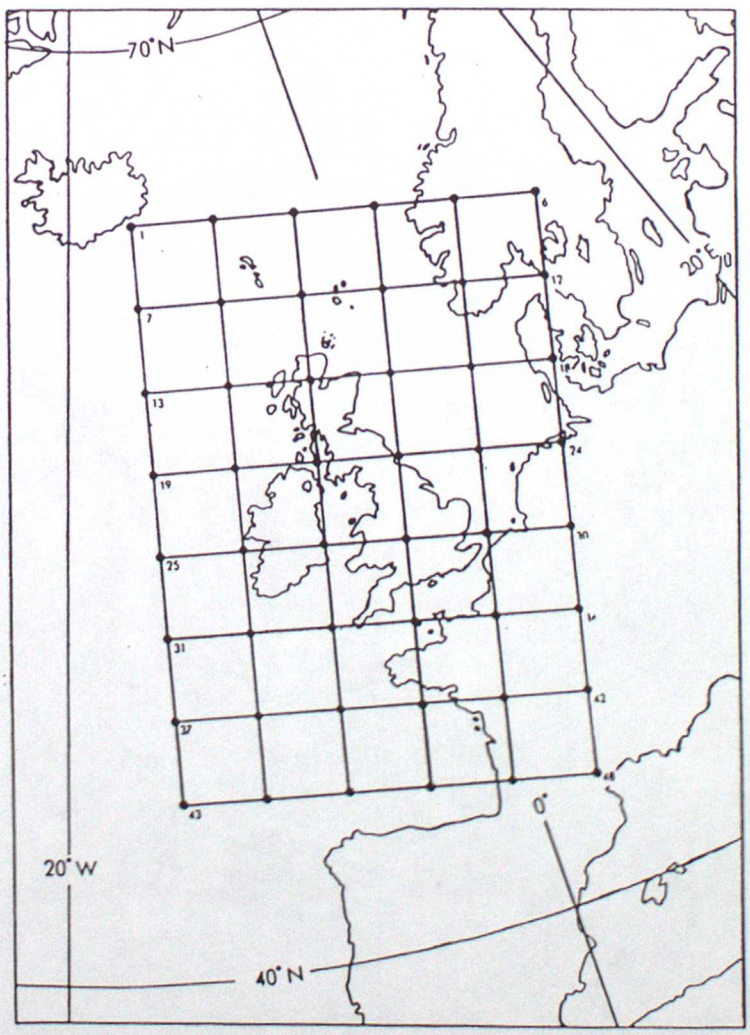


Figure 2. 48-Point Verification Area

## TABLE 1: ANNUAL MEAN STATISTICS FOR AREA 2

## VERIFICATION AGAINST OBSERVATIONS

| | ANALYSES | | | 24-HR F/C | | | 48-HR F/C | | | 72-HR F/C | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | H200 | H500 | PMSL | H200 | H500 | PMSL | H200 | H500 | PMSL | H200 | H500 | PMSL |
| 1978 | 32 | 15 | 15 | 51 | 35 | 38 | 76 | 57 | 56 | 88 | 79 | 74 |
| 1979 | 32 | 16 | 14 | 50 | 34 | 35 | 75 | 57 | 55 | 87 | 79 | 74 |
| 1980 | 30 | 16 | 14 | 47 | 33 | 34 | 70 | 55 | 53 | 82 | 77 | 70 |
| 1981 | 28 | 15 | 14 | 47 | 34 | 35 | 70 | 56 | 55 | 86 | 75 | 72 |
| 1982 | 30 | 17 | 19 | 44 | 32 | 35 | 65 | 51 | 53 | 82 | 73 | 71 |
| 1983 | 30 | 20 | 17 | 41 | 30 | 31 | 60 | 48 | 48 | 78 | 72 | 69 |
| 1984 | 26 | 18 | 18 | 37 | 28 | 30 | 55 | 47 | 47 | 81 | 69 | 66 |
| 1985 | 25 | 16 | 17 | 35 | 26 | 29 | 50 | 42 | 43 | 71 | 61 | 59 |
| 1986 | 28 | 16 | 16 | 37 | 26 | 28 | 52 | 40 | 42 | 70 | 55 | 55 |
| 1987 | 28 | 17 | 17 | 37 | 25 | 28 | 52 | 40 | 41 | 72 | 58 | 56 |
| 1988 | 28 | 17 | 22 | 36 | 25 | 31 | 50 | 40 | 43 | 70 | 57 | 57 |
| 1989 | 28 | 17 | 17 | 36 | 26 | 27 | 51 | 41 | 40 | 72 | 58 | 54 |
| 1990 | 26 | 17 | 17 | 35 | 26 | 27 | 50 | 41 | 41 | 71 | 57 | 55 |
| 1991 | 27 | 16 | 16 | 38 | 25 | 26 | 55 | 39 | 40 | 77 | 57 | 55 |
| 1992† | 27 | 16 | 15 | 43 | 25 | 26 | 60 | 39 | 39 | 79 | 55 | 53 |
| 1993 | 22 | 14 | 14 | 34 | 22 | 24 | 50 | 36 | 37 | 71 | 54 | 52 |
| 1994 | 24 | 14 | 14 | 34 | 22 | 23 | 49 | 37 | 37 | 66 | 53 | 52 |
| 1995 | 21 | 13 | 13 | 29 | 20 | 21 | 42 | 31 | 33 | 59 | 47 | 47 |
| 1996 | 18 | 12 | 11 | 25 | 18 | 19 | 37 | 29 | 29 | 52 | 43 | 40 |
| 1997 | 17 | 12 | 11 | 25 | 19 | 18 | 36 | 29 | 29 | 51 | 42 | 41 |
| 1998 | 17 | 12 | 11 | 24 | 17 | 18 | 34 | 27 | 27 | 49 | 40 | 39 |
| 1999 | 16 | 11 | 10 | 22 | 16 | 16 | 32 | 25 | 24 | 46 | 38 | 35 |
| 2000 | 16 | 11 | 10 | 22 | 15 | 16 | 31 | 24 | 24 | 43 | 36 | 34 |

Table 1(a) Rms errors of the forecast for geopotential height at 200 and 500 hPa (H200 and H500, in metres) and PMSL (in tenths of hPa). (Also see graph in Figure 3a
(† 1992 values are for the 12-month period Nov'91-Oct'92)

| | ANALYSES | | | 24-HR F/C | | | 48-HR F/C | | | 72-HR F/C | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | H200 | H500 | PMSL | H200 | H500 | PMSL | H200 | H500 | PMSL | H200 | H500 | PMSL |
| 1978 | -2 | 1 | 0 | -5 | -2 | 6 | -15 | -8 | 1 | -20 | -9 | 3 |
| 1979 | -1 | 1 | 0 | -8 | -4 | 5 | -18 | -10 | -1 | -24 | -11 | 1 |
| 1980 | 0 | 1 | -1 | -3 | -2 | 5 | -10 | -7 | -2 | -13 | -6 | -2 |
| 1981 | 0 | 2 | -1 | -3 | -2 | 5 | -10 | -8 | -2 | -15 | -9 | -1 |
| 1982 | -4 | -1 | -1 | -6 | -3 | 0 | -12 | -8 | -4 | -20 | -12 | -7 |
| 1983 | -12 | -10 | 0 | -10 | -13 | -4 | -20 | -23 | -12 | -34 | -35 | -23 |
| 1984 | -10 | -10 | 3 | -10 | -12 | 0 | -18 | -22 | -8 | -30 | -33 | -18 |
| 1985 | -6 | -6 | 2 | -6 | -9 | 2 | -12 | -16 | -3 | -18 | -22 | -4 |
| 1986 | 1 | -2 | 1 | 0 | -6 | 0 | -6 | -12 | -4 | -10 | -14 | -3 |
| 1987 | 3 | -2 | 2 | 1 | -7 | 4 | -9 | -17 | -2 | -19 | -25 | -4 |
| 1988 | 2 | -2 | 1 | -1 | -7 | 2 | -8 | -13 | -1 | -14 | -17 | -2 |
| 1989 | 0 | -4 | 0 | -5 | -8 | 1 | -11 | -15 | -1 | -17 | -19 | -1 |
| 1990 | -2 | -5 | 0 | -7 | -10 | 0 | -13 | -15 | -1 | -19 | -20 | -1 |
| 1991 | -9 | -6 | 0 | -19 | -10 | 0 | -28 | -14 | -1 | -37 | -17 | -3 |
| 1992† | -13 | -6 | 0 | -29 | -12 | 1 | -41 | -15 | 0 | -48 | -16 | 1 |
| 1993 | -7 | -2 | 1 | -19 | -8 | -1 | -28 | -14 | -4 | -36 | -18 | -4 |
| 1994 | -7 | -2 | 1 | -19 | -9 | -2 | -29 | -16 | -6 | -33 | -18 | -7 |
| 1995 | -6 | -2 | 1 | -13 | -2 | 4 | -18 | -4 | 4 | -20 | -3 | 5 |
| 1996 | -3 | -1 | 0 | -8 | 1 | 4 | -11 | 1 | 5 | -12 | 2 | 6 |
| 1997 | -4 | -1 | -1 | -9 | 0 | 4 | -11 | 2 | 7 | -11 | 3 | 9 |
| 1998 | -3 | -0 | 1 | -7 | -1 | 3 | -10 | -1 | 4 | -12 | -1 | 4 |
| 1999 | -5 | -2 | 0 | -11 | -2 | 3 | -14 | -2 | 3 | -14 | -1 | 6 |
| 2000 | -5 | -2 | -1 | -9 | -2 | 2 | -12 | -2 | 3 | -12 | 0 | 5 |

Table 1(b) Mean errors of the forecast for geopotential height at 200 and 500 hPa (H200 and H500, in metres) and PMSL (in tenths of hPa). (Also see graph in Figure 3b)
(† 1992 values are for the 12-month period Nov'91-Oct'92)

| | ANALYSES | | 24-HR F/C | | 48-HR F/C | | 72-HR F/C | |
|---|---|---|---|---|---|---|---|---|
| | W200 | W500 | W200 | W500 | W200 | W500 | W200 | W500 |
| 1978 | 12 | 11 | 17 | 15 | 23 | 20 | 28 | 24 |
| 1979 | 12 | 11 | 17 | 15 | 23 | 20 | 28 | 25 |
| 1980 | 12 | 11 | 17 | 15 | 22 | 19 | 27 | 24 |
| 1981 | 12 | 11 | 17 | 15 | 22 | 20 | 27 | 24 |
| 1982 | 11 | 10 | 16 | 15 | 21 | 19 | 26 | 23 |
| 1983 | 8 | 7 | 15 | 13 | 19 | 17 | 25 | 22 |
| 1984 | 8 | 7 | 14 | 13 | 19 | 17 | 24 | 22 |
| 1985 | 9 | 8 | 14 | 13 | 18 | 17 | 22 | 21 |
| 1986 | 9 | 8 | 14 | 13 | 18 | 16 | 22 | 20 |
| 1987 | 9 | 8 | 13 | 12 | 18 | 16 | 22 | 20 |
| 1988 | 9 | 8 | 13 | 12 | 17 | 16 | 22 | 20 |
| 1989 | 10 | 8 | 13 | 12 | 17 | 16 | 22 | 20 |
| 1990 | 9 | 8 | 13 | 12 | 17 | 16 | 22 | 20 |
| 1991 | 9 | 8 | 12 | 11 | 17 | 15 | 22 | 20 |
| 1992† | 8 | 8 | 12 | 12 | 16 | 16 | 22 | 20 |
| 1993 | 8 | 7 | 12 | 11 | 16 | 15 | 21 | 20 |
| 1994 | 8 | 7 | 12 | 11 | 16 | 15 | 21 | 19 |
| 1995 | 8 | 7 | 11 | 11 | 15 | 14 | 20 | 19 |
| 1996 | 8 | 8 | 11 | 11 | 14 | 14 | 18 | 18 |
| 1997 | 8 | 7 | 11 | 11 | 15 | 14 | 19 | 18 |
| 1998 | 8 | 7 | 11 | 10 | 14 | 13 | 18 | 17 |
| 1999 | 7 | 7 | 10 | 10 | 13 | 13 | 17 | 17 |
| 2000 | 7 | 6 | 10 | 10 | 13 | 12 | 16 | 16 |

Table 1(c) Rms vector wind errors of the forecasts at 200 and 500 hPa (W200 and W500) in knots.
(† 1992 values are for the 12-month period Nov'91-Oct'92)

| | ANALYSES | | | 24-HR FORECAST | | | 48-HR FORECAST | | |
|---|---|---|---|---|---|---|---|---|---|
| | T200 | T500 | SURF | T200 | T500 | SURF | T200 | T500 | SURF |
| 1978 | 2.9 | 1.5 | 4.6 | 3.6 | 1.9 | 4.3 | 4.6 | 2.7 | 4.9 |
| 1979 | 2.9 | 1.5 | 4.4 | 3.7 | 1.9 | 4.2 | 4.7 | 2.7 | 4.8 |
| 1980 | 2.9 | 1.4 | 4.3 | 3.7 | 1.9 | 4.1 | 4.7 | 2.6 | 4.6 |
| 1981 | 2.8 | 1.4 | 4.3 | 3.6 | 1.9 | 4.0 | 4.5 | 2.7 | 4.5 |
| 1982 | 2.5 | 1.3 | 3.9 | 3.3 | 1.8 | 4.0 | 4.1 | 2.5 | 4.5 |
| 1983 | 1.8 | 0.9 | 2.8 | 2.7 | 1.7 | 3.6 | 3.2 | 2.3 | 3.9 |
| 1984 | 1.8 | 0.9 | 2.7 | 2.5 | 1.6 | 3.2 | 3.2 | 2.3 | 3.6 |
| 1985 | 1.8 | 0.9 | 2.9 | 2.5 | 1.6 | 3.3 | 3.0 | 2.2 | 3.7 |
| 1986 | 1.9 | 0.9 | 2.9 | 2.5 | 1.6 | 3.2 | 3.1 | 2.2 | 3.6 |
| 1987 | 1.9 | 1.0 | 2.8 | 2.5 | 1.6 | 3.2 | 3.1 | 2.2 | 3.6 |
| 1988 | 1.9 | 1.0 | 2.9 | 2.5 | 1.6 | 3.3 | 3.1 | 2.2 | 3.6 |
| 1989 | 2.0 | 1.1 | 2.9 | 2.5 | 1.6 | 3.2 | 3.0 | 2.2 | 3.5 |
| 1990 | 1.9 | 1.1 | 2.9 | 2.4 | 1.6 | 3.2 | 3.0 | 2.2 | 3.5 |
| 1991 | 1.6 | 1.0 | 2.8 | 2.2 | 1.5 | 3.1 | 2.8 | 2.0 | 3.4 |
| 1992† | 1.6 | 1.0 | 2.7 | 2.1 | 1.5 | 2.9 | 2.7 | 2.1 | 3.2 |
| 1993 | 1.4 | 0.9 | 2.7 | 2.0 | 1.3 | 3.0 | 2.6 | 1.9 | 3.3 |
| 1994 | 1.4 | 0.9 | 2.8 | 2.0 | 1.3 | 2.9 | 2.7 | 1.9 | 3.2 |
| 1995 | 1.4 | 0.9 | 2.7 | 2.0 | 1.3 | 2.8 | 2.5 | 1.8 | 3.0 |
| 1996 | 1.3 | 0.8 | 2.8 | 1.9 | 1.2 | 2.9 | 2.4 | 1.7 | 3.2 |
| 1997 | 1.4 | 0.8 | 2.7 | 1.9 | 1.2 | 2.9 | 2.4 | 1.7 | 3.1 |
| 1998 | 1.3 | 0.8 | 2.5 | 1.8 | 1.2 | 2.8 | 2.2 | 1.6 | 3.1 |
| 1999 | 1.2 | 0.8 | 2.4 | 1.7 | 1.1 | 2.7 | 2.1 | 1.6 | 2.9 |
| 2000 | 1.2 | 0.7 | 2.2 | 1.6 | 1.1 | 2.5 | 2.0 | 1.5 | 2.7 |

Table 1(d) Rms errors of the forecasts of temperature at 200 and 500 hPa (T200 and T500) and at 1.5m above the surface (SURF), all in degrees K.
(† 1992 values are for the 12-month period Nov'91-Oct'92)

| | ANALYSES | | | 24-HR FORECAST | | | 48-HR FORECAST | | |
|---|---|---|---|---|---|---|---|---|---|
| | T200 | T500 | SURF | T200 | T500 | SURF | T200 | T500 | SURF |
| 1978 | -l.2 | -0.2 | -0.2 | -1.7 | -0.1 | -1.0 | -2.2 | -0.1 | -1.2 |
| 1979 | -1.1 | -0.3 | -0.3 | -1.8 | -0.2 | -1.2 | -2.3 | -0.1 | -1.5 |
| 1980 | -1.3 | -0.3 | -0.1 | -1.9 | -0.1 | -1.2 | -2.5 | 0.1 | -1.4 |
| 1981 | -1.1 | -0.2 | 0.0 | -1.6 | -0.1 | -1.1 | -2.0 | 0.0 | -1.4 |
| 1982 | -0.6 | -0.2 | 0.0 | -0.9 | -0.1 | -0.4 | -1.2 | -0.1 | -0.5 |
| 1983 | 0.3 | -0.3 | -0.6 | 0.5 | -0.3 | -0.1 | 0.5 | -0.4 | -0.1 |
| 1984 | 0.3 | -0.3 | -0.8 | 0.4 | -0.3 | -0.7 | 0.3 | -0.4 | -0.8 |
| 1985 | 0.2 | -0.3 | -0.7 | 0.3 | -0.3 | -0.6 | 0.2 | -0.4 | -0.6 |
| 1986 | 0.5 | -0.2 | -0.9 | 0.6 | -0.3 | -0.7 | 0.6 | -0.4 | -0.7 |
| 1987 | 0.6 | -0.3 | -1.1 | 0.8 | -0.4 | -1.0 | 0.8 | -0.6 | -1.1 |
| 1988 | 0.5 | -0.2 | -0.8 | 0.6 | -0.3 | -0.8 | 0.6 | -0.4 | -0.9 |
| 1989 | 0.5 | -0.2 | -0.8 | 0.5 | -0.4 | -0.8 | 0.5 | -0.6 | -0.9 |
| 1990 | 0.4 | -0.2 | -0.9 | 0.4 | -0.4 | -0.9 | 0.4 | -0.6 | -0.9 |
| 1991 | 0.4 | -0.2 | -0.7 | 0.4 | -0.4 | -0.7 | 0.2 | -0.5 | -0.7 |
| 1992† | 0.2 | -0.2 | -0.9 | 0.3 | -0.5 | -1.0 | 0.2 | -0.7 | -1.1 |
| 1993 | 0.3 | -0.1 | -1.0 | 0.5 | -0.2 | -1.3 | 0.5 | -0.3 | -1.4 |
| 1994 | 0.2 | -0.1 | -1.2 | 0.5 | -0.3 | -1.2 | 0.6 | -0.3 | -1.3 |
| 1995 | 0.2 | -0.1 | -0.9 | 0.4 | -0.2 | -1.0 | 0.4 | -0.2 | -1.1 |
| 1996 | 0.2 | -0.1 | -1.2 | 0.4 | -0.2 | -1.2 | 0.4 | -0.2 | -1.3 |
| 1997 | 0.3 | -0.1 | -1.3 | 0.5 | -0.2 | -1.3 | 0.5 | -0.2 | -1.4 |
| 1998 | 0.3 | -0.0 | -1.1 | 0.5 | -0.1 | -1.3 | 0.5 | -0.1 | -1.5 |
| 1999 | 0.3 | -0.1 | -1.1 | 0.4 | -0.2 | -1.2 | 0.4 | -0.2 | -1.3 |
| 2000 | 0.2 | -0.0 | -0.9 | 0.3 | -0.2 | -1.0 | 0.3 | -0.2 | -1.1 |

Table 1(e) Mean errors of the forecasts of temperature at 200 and 500 hPa (T200 and T500) and at 1.5m above the surface (SURF), all in degrees K.
(† 1992 values are for the 12-month period Nov'91-Oct'92)

## TABLE 2: ANNUAL MEAN STATISTICS FOR AREA 2

## VERIFICATION AGAINST ANALYSES

| | 24-HR FORECAST | | | 48-HR FORECAST | | | 72-HR FORECAST | | |
|---|---|---|---|---|---|---|---|---|---|
| | H200 | H500 | PMSL | H200 | H500 | PMSL | H200 | H500 | PMSL |
| 1967 | 54/*** | 42/** | 44/** | 97/*** | 76/*** | 73/*** | | | |
| 1968 | 51/*** | 42/** | 44/** | 90/*** | 72/*** | 73/*** | | | |
| 1969 | 50/*** | 42/** | 42/** | 86/*** | 71/*** | 71/*** | | | |
| 1970 | 50/*** | 43/** | 43/** | 86/*** | 71/*** | 72/*** | | | |
| 1971 | 54/*** | 45/** | 44/** | 91/*** | 77/*** | 75/*** | | | |
| 1972 | 54/*** | 44/** | 45/** | 96/*** | 75/*** | 75/*** | | | |
| 1973 | 50/ 84 | 39/73 | 43/72 | 87/126 | 68/107 | 70/ 98 | 120/144 | 94/123 | 89/108 |
| 1974 | 53/ 89 | 41/74 | 42/71 | 93/130 | 70/105 | 67/ 93 | 131/151 | 97/121 | 87/103 |
| 1975 | 53/ 94 | 41/78 | 41/72 | 90/137 | 69/112 | 65/ 97 | 125/159 | 94/128 | 84/108 |
| 1976 | 54/ 97 | 42/80 | 41/75 | 91/140 | 69/112 | 65/100 | 125/159 | 93/127 | 84/109 |
| 1977 | 54/ 99 | 40/81 | 39/72 | 83/145 | 65/116 | 61/ 98 | 112/168 | 88/134 | 79/110 |
| 1978 | 46/102 | 36/82 | 38/75 | 73/146 | 58/114 | 57/100 | 99/167 | 79/130 | 74/111 |
| 1979 | 45/ 99 | 35/81 | 36/74 | 71/146 | 58/116 | 54/100 | 98/169 | 80/133 | 74/112 |
| 1980 | 42/ 99 | 34/82 | 35/77 | 67/141 | 56/114 | 53/103 | 94/161 | 77/130 | 70/112 |
| 1981 | 42/100 | 34/83 | 36/75 | 68/145 | 56/116 | 54/101 | 95/165 | 76/131 | 71/110 |
| 1982 | 41/100 | 33/83 | 35/80 | 63/143 | 52/115 | 52/105 | 89/166 | 72/131 | 71/114 |
| 1983 | 36/ 98 | 27/80 | 34/81 | 55/144 | 43/114 | 50/108 | 79/168 | 63/130 | 69/119 |
| 1984 | 31/ 94 | 24/78 | 31/77 | 50/140 | 41/111 | 47/103 | 74/163 | 62/129 | 65/116 |
| 1985 | 30/ 94 | 23/78 | 29/77 | 48/138 | 40/111 | 44/104 | 70/161 | 59/129 | 60/116 |
| 1986 | 28/ 98 | 22/79 | 28/80 | 48/140 | 38/109 | 42/104 | 70/158 | 54/123 | 56/113 |
| 1987 | 28/ 95 | 22/76 | 26/77 | 49/140 | 39/108 | 42/102 | 72/163 | 57/125 | 57/112 |
| 1988 | 26/ 99 | 21/81 | 26/80 | 46/140 | 37/115 | 41/106 | 68/166 | 55/131 | 56/115 |
| 1989 | 25/100 | 19/80 | 24/82 | 46/143 | 36/111 | 40/106 | 69/164 | 55/128 | 56/116 |
| 1990 | 25/102 | 19/81 | 24/82 | 45/148 | 36/114 | 40/109 | 68/167 | 54/129 | 56/119 |
| 1991 | 26/ 97 | 18/78 | 22/78 | 47/143 | 35/110 | 38/103 | 70/165 | 54/127 | 55/113 |
| 1992 | 28/ 91 | 19/78 | 22/76 | 50/135 | 35/111 | 37/101 | 71/158 | 53/128 | 53/112 |
| 1993 | 24/ 91 | 17/76 | 20/75 | 43/136 | 33/107 | 35/100 | 64/158 | 51/125 | 51/111 |
| 1994 | 24/ 95 | 17/78 | 21/76 | 41/138 | 32/111 | 35/102 | 61/158 | 50/125 | 51/113 |
| 1995 | 20/ 92 | 15/75 | 18/75 | 36/137 | 29/108 | 31/103 | 55/160 | 45/126 | 45/115 |
| 1996 | 19/ 93 | 15/75 | 17/74 | 34/139 | 28/109 | 29/106 | 52/163 | 44/127 | 43/112 |
| 1997 | 19/ 94 | 14/75 | 17/75 | 32/138 | 27/108 | 29/100 | 50/160 | 43/125 | 43/111 |
| 1998 | 17/ 88 | 13/70 | 16/70 | 30/130 | 25/102 | 28/ 96 | 46/154 | 40/120 | 40/107 |
| 1999 | 15/ 89 | 13/75 | 15/73 | 26/134 | 24/109 | 25/101 | 42/156 | 38/127 | 38/113 |
| 2000 | 15/ 88 | 13/73 | 15/72 | 26/129 | 23/104 | 24/ 97 | 41/149 | 36/120 | 36/108 |

Table 2(a) Rms errors of the forecast and persistence for geopotential height at 200 and 500 hPa (H200 and H500, in metres) and PMSL (in tenths of hPa). (Also see graph in Figure 4a)

| | 24-HR FORECAST | | | 48-HR FORECAST | | | 72-HR FORECAST | | |
|---|---|---|---|---|---|---|---|---|---|
| | H200 | H500 | PMSL | H200 | H500 | PMSL | H200 | H500 | PMSL |
| 1973 | 14/** | 4/** | -2/** | 23/** | 5/** | -9/** | 32/** | 5/** | -18/** |
| 1974 | 23/** | 10/** | 3/** | 40/** | 15/** | -1/** | 55/** | 19/** | -7/** |
| 1975 | 25/** | 11/** | 3/** | 43/** | 15/** | -3/** | 57/** | 18/** | -11/** |
| 1976 | 27/ 1 | 13/ 0 | 6/ 0 | 43/-1 | 18/ 0 | 1/ 0 | 57/-2 | 22/ 0 | -6/ 0 |
| 1977 | 27/ 0 | 14/ 0 | 9/ 0 | 35/ 0 | 14/ 0 | 0/ 0 | 41/-1 | 14/ 0 | -6/ 0 |
| 1978 | -1/ 0 | 1/ 0 | 8/ 0 | -11/ 0 | -2/ 0 | 5/ 0 | -14/-1 | 0/ 0 | 7/ 0 |
| 1979 | -4/ 0 | -1/ 0 | 6/ 0 | -15/-1 | -5/ 0 | 1/ 0 | -19/-1 | -4/ 0 | 2/ 0 |
| 1980 | 0/ 0 | -1/ 0 | 7/ 0 | -9/ 1 | -5/ 0 | 2/ 0 | -13/ 1 | -4/ 0 | 3/ 0 |
| 1981 | 0/ 0 | -1/ 0 | 7/ 0 | -10/ 0 | -6/ 0 | 2/ 1 | -14/ 0 | -6/ 1 | 3/ 2 |
| 1982 | -3/ 0 | -2/ 0 | 2/ 0 | -10/ 1 | -4/ 1 | -2/ 0 | -15/ 1 | -6/ 1 | -4/ 1 |
| 1983 | -1/ 1 | -3/ 1 | -2/ 1 | -9/ 2 | -10/ 1 | -9/ 2 | -18/ 2 | -17/ 2 | -18/ 3 |
| 1984 | 0/ 0 | -3/ 0 | -1/ 0 | -8/-1 | -10/-1 | -7/ 0 | -18/-2 | -19/-1 | -15/ 0 |
| 1985 | -1/-8 | -2/ 0 | 1/-7 | -9/-5 | -9/ 0 | -2/-7 | -17/-3 | -14/ 0 | -4/-7 |
| 1986 | -3/-1 | -3/ 0 | 1/ 0 | -10/-1 | -8/-1 | -1/-1 | -15/-1 | -11/-1 | -2/-1 |
| 1987 | -3/-1 | -3/ 0 | 3/ 0 | -13/-1 | -9/-1 | 0/-1 | -22/-1 | -15/-1 | -2/-1 |
| 1988 | -4/ 0 | -3/ 0 | 3/ 0 | -13/ 0 | -9/ 0 | 1/ 0 | -22/ 1 | -15/ 1 | -2/ 0 |
| 1989 | -7/ 0 | -4/ 0 | 2/ 0 | -14/-1 | -9/-1 | 0/ 0 | -20/-1 | -14/-1 | -2/ 0 |
| 1990 | -7/ 0 | -5/ 0 | 1/ 0 | -14/ 1 | -9/ 0 | 0/ 0 | -20/ 1 | -13/ 0 | -2/ 0 |
| 1991 | -12/ 0 | -4/ 0 | 1/ 0 | -22/ 0 | -7/ 0 | 1/-1 | -30/ 0 | -10/ 0 | 0/ 0 |
| 1992 | -17/ 0 | -6/ 0 | 0/ 0 | -29/ 1 | -9/ 0 | 0/ 0 | -37/ 1 | -10/ 1 | 0/ 0 |
| 1993 | -14/ 0 | -6/ 0 | -1/ 0 | -23/ 0 | -10/ 0 | -2/ 0 | -30/ 0 | -13/ 0 | -3/ 0 |
| 1994 | -14/ 0 | -6/ 0 | -2/ 0 | -22/ 0 | -10/ 0 | -4/ 0 | -27/ 0 | -13/ 0 | -7/ 0 |
| 1995 | -9/ 0 | -1/ 0 | 2/ 0 | -13/ 1 | -2/ 0 | 4/ 0 | -16/ 1 | -1/ 0 | 5/ 0 |
| 1996 | -6/ 0 | 1/ 0 | 3/-3 | -9/ 0 | 2/ 0 | 5/-6 | -11/-1 | 2/ 0 | 5/-9 |
| 1997 | -7/ 0 | 0/ 0 | 2/ 4 | -7/ 0 | 3/ 0 | 6/ 8 | -7/ 0 | 5/ 0 | 8/11 |
| 1998 | -5/ 0 | 0/ 0 | 2/ 0 | -7/ 0 | 1/ 0 | 4/ 0 | -8/ 0 | 1/ 0 | 4/ 0 |
| 1999 | -4/ 0 | 2/ 0 | 4/ 0 | -5/ 0 | 2/ 0 | 5/ 0 | -6/ 0 | 2/ 0 | 6/ 0 |
| 2000 | -3/ 0 | 2/ 0 | 3/ 0 | -5/ 0 | 2/ 0 | 3/ 0 | -6/ 0 | 2/ 0 | 3/ 0 |

Table 2(b) Mean errors of the forecast and persistence for geopotential height at 200 and 500 hPa (H200 and H500, in metres) and PMSL (in tenths of hPa). (Also see graph in Figure 4b)

| | 24-HR FORECAST | | | 48-HR FORECAST | | | 72-HR FORECAST | | |
|---|---|---|---|---|---|---|---|---|---|
| | W200 | W500 | SURF | W200 | W500 | SURF | W200 | W500 | SURF |
| 1967 | 21/** | 17/** | | 31/** | 25/** | | | | |
| 1968 | 20/** | 17/** | | 29/** | 25/** | | | | |
| 1969 | 19/** | 17/** | | 29/** | 25/** | | | | |
| 1970 | 20/** | 18/** | | 29/** | 26/** | | | | |
| 1971 | 20/** | 19/** | | 30/** | 27/** | | | | |
| 1972 | 21/** | 18/** | | 29/** | 26/** | | | | |
| 1973 | 16/27 | 15/25 | | 23/36 | 22/32 | | 29/39 | 27/35 | |
| 1974 | 16/28 | 15/25 | | 23/37 | 21/31 | | 29/40 | 27/34 | |
| 1975 | 17/29 | 16/27 | | 24/38 | 22/34 | | 30/41 | 28/36 | |
| 1976 | 17/30 | 16/27 | | 23/39 | 22/33 | | 30/41 | 26/35 | |
| 1977 | 16/31 | 14/27 | 7/12 | 22/40 | 19/34 | 9/15 | 27/43 | 24/37 | 11/16 |
| 1978 | 16/31 | 14/28 | 7/12 | 22/40 | 19/34 | 9/14 | 27/43 | 23/37 | 11/15 |
| 1979 | 16/31 | 14/27 | 7/12 | 21/40 | 19/35 | 9/14 | 27/44 | 24/37 | 11/15 |
| 1980 | 15/31 | 13/28 | 6/13 | 20/39 | 18/34 | 8/15 | 26/42 | 23/36 | 10/16 |
| 1981 | 15/31 | 13/28 | 7/12 | 21/41 | 18/35 | 9/15 | 26/43 | 23/37 | 10/15 |
| 1982 | 16/33 | 14/29 | 8/14 | 20/41 | 19/36 | 9/16 | 26/45 | 23/38 | 11/17 |
| 1983 | 16/35 | 14/31 | 8/15 | 20/44 | 18/37 | 10/17 | 25/48 | 22/39 | 11/18 |
| 1984 | 14/34 | 13/29 | 7/13 | 19/43 | 17/35 | 9/15 | 24/46 | 21/38 | 10/16 |
| 1985 | 14/33 | 13/29 | 6/12 | 18/41 | 16/35 | 8/14 | 23/44 | 23/37 | 9/14 |
| 1986 | 13/34 | 11/29 | 7/13 | 17/42 | 15/34 | 8/15 | 22/44 | 22/36 | 10/16 |
| 1987 | 12/32 | 11/27 | 7/14 | 17/41 | 15/33 | 9/16 | 22/45 | 22/36 | 11/17 |
| 1988 | 11/33 | 10/28 | 6/14 | 16/42 | 14/35 | 8/16 | 21/44 | 21/36 | 10/16 |
| 1989 | 10/32 | 8/27 | 6/14 | 15/40 | 13/32 | 8/15 | 20/43 | 18/35 | 10/16 |
| 1990 | 10/33 | 8/27 | 5/13 | 15/42 | 13/34 | 8/15 | 21/44 | 18/35 | 10/16 |
| 1991 | 10/32 | 8/27 | 5/13 | 15/41 | 13/33 | 7/15 | 21/45 | 18/35 | 10/15 |
| 1992 | 10/31 | 8/27 | 5/13 | 16/40 | 13/33 | 7/15 | 21/43 | 19/36 | 9/15 |
| 1993 | 10/32 | 8/27 | 5/13 | 15/41 | 13/33 | 7/15 | 20/44 | 18/35 | 9/16 |
| 1994 | 10/33 | 8/27 | 5/13 | 15/42 | 13/33 | 7/15 | 20/45 | 18/35 | 9/16 |
| 1995 | 9/32 | 7/26 | 4/13 | 14/41 | 12/32 | 6/15 | 19/44 | 17/34 | 8/16 |
| 1996 | 8/32 | 7/26 | 4/12 | 13/42 | 12/33 | 6/15 | 18/46 | 16/36 | 8/16 |
| 1997 | 8/32 | 7/27 | 4/13 | 13/41 | 11/33 | 6/15 | 18/46 | 16/36 | 8/16 |
| 1998 | 8/32 | 7/25 | 4/13 | 13/41 | 11/31 | 6/15 | 18/44 | 16/34 | 8/15 |
| 1999 | 7/31 | 6/27 | 4/13 | 11/41 | 11/34 | 6/15 | 16/44 | 15/36 | 8/16 |
| 2000 | 7/32 | 6/26 | 4/13 | 11/40 | 10/32 | 6/15 | 16/43 | 15/35 | 8/16 |

Table 2(c) Rms vector wind errors of the forecast and persistence at 200 and 500 hPa (W200 and W500) and at 10m above the surface (SURF), all in knots. (Also see graphs in Figures 5a and 5b)

## TABLE 3: ANNUAL MEAN STATISTICS FOR THE NORTHERN HEMISPHERE

## VERIFICATION AGAINST ANALYSES

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | 34/70 | 50/94 | 65/105 | 80/110 | 93/114 | 106/115 |
| 1985 | 32/70 | 45/95 | 58/105 | 71/107 | 82/109 | 91/110 |
| 1986 | 30/72 | 43/95 | 56/103 | 69/109 | 80/112 | 91/114 |
| 1987 | 29/69 | 42/93 | 55/103 | 69/109 | 78/113 | 88/116 |
| 1988 | 28/71 | 41/95 | 54/104 | 67/109 | 78/112 | 87/115 |
| 1989 | 24/70 | 39/94 | 53/103 | 66/110 | 77/115 | 87/118 |
| 1990 | 24/71 | 39/96 | 52/105 | 66/111 | 78/115 | 87/117 |
| 1991 | 23/69 | 38/93 | 52/102 | 65/108 | 78/112 | 89/116 |
| 1992 | 22/67 | 38/91 | 52/101 | 64/106 | 77/109 | 88/112 |
| 1993 | 22/68 | 36/91 | 49/101 | 62/106 | 75/109 | 86/112 |
| 1994 | 22/67 | 35/91 | 48/100 | 61/111 | 75/112 | 87/112 |
| 1995 | 18/66 | 30/91 | 42/102 | 55/108 | 67/112 | 79/115 |
| 1996 | 19/68 | 31/95 | 43/106 | 52/113 | 67/116 | 80/119 |
| 1997 | 18/68 | 30/93 | 42/103 | 54/109 | 67/112 | 79/115 |
| 1998 | 18/66 | 28/89 | 40/ 98 | 52/104 | 66/109 | 78/112 |
| 1999 | 18/67 | 28/93 | 39/104 | 52/109 | 65/113 | 77/115 |
| 2000 | 16/66 | 25/88 | 36/ 97 | 49/103 | 61/106 | 74/108 |

Table 3(a) Rms errors of the forecast and persistence for PMSL (in tenths of hPa).
(Also see graph in Figure 6a)

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | -1 | -5 | -9 | -11 | -11 | -14 |
| 1985 | 0 | -2 | -3 | -3 | -2 | -3 |
| 1986 | 1 | -2 | -3 | -3 | -3 | -3 |
| 1987 | 1 | 0 | 0 | 0 | 1 | 0 |
| 1988 | 0 | 0 | 0 | -1 | -1 | -2 |
| 1989 | 1 | 1 | 1 | 1 | 2 | 2 |
| 1990 | 1 | 2 | 1 | 1 | 2 | 1 |
| 1991 | 0 | -1 | -1 | -1 | -1 | -2 |
| 1992 | -3 | -4 | -4 | -3 | -4 | -4 |
| 1993 | -2 | -4 | -4 | -4 | -4 | -5 |
| 1994 | -3 | -5 | -5 | -5 | -6 | -6 |
| 1995 | 1 | 0 | 1 | 3 | 4 | 4 |
| 1996 | 1 | 1 | 3 | 5 | 6 | 6 |
| 1997 | 1 | 2 | 3 | 5 | 5 | 7 |
| 1998 | 0 | -1 | 1 | 3 | 2 | 3 |
| 1999 | 0 | 0 | 1 | 2 | 2 | 2 |
| 2000 | 1 | 1 | 2 | 3 | 3 | 4 |

Table 3(b) Mean errors of the forecast for PMSL (in tenths of hPa).

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | 25/68 | 40/ 96 | 57/112 | 74/120 | 90/125 | 103/128 |
| 1985 | 23/68 | 38/ 98 | 53/114 | 68/117 | 82/120 | 93/122 |
| 1986 | 22/70 | 36/ 98 | 51/111 | 66/120 | 79/127 | 91/132 |
| 1987 | 21/67 | 36/ 96 | 50/111 | 65/121 | 79/127 | 92/131 |
| 1988 | 21/70 | 35/ 99 | 51/113 | 66/122 | 80/128 | 92/133 |
| 1989 | 18/68 | 33/ 98 | 49/113 | 65/123 | 79/130 | 91/135 |
| 1990 | 18/68 | 33/ 98 | 48/111 | 63/119 | 78/126 | 90/130 |
| 1991 | 17/67 | 32/ 96 | 48/110 | 64/121 | 80/128 | 94/133 |
| 1992 | 17/66 | 32/ 95 | 47/110 | 62/118 | 78/124 | 91/127 |
| 1993 | 16/66 | 30/ 95 | 45/109 | 61/117 | 77/123 | 92/128 |
| 1994 | 16/67 | 29/ 96 | 44/109 | 60/118 | 77/124 | 92/128 |
| 1995 | 14/64 | 26/ 94 | 39/109 | 54/120 | 69/127 | 83/131 |
| 1996 | 14/67 | 27/ 98 | 41/115 | 56/125 | 71/131 | 86/136 |
| 1997 | 14/66 | 26/ 96 | 39/111 | 54/121 | 70/128 | 84/133 |
| 1998 | 13/64 | 25/ 91 | 38/106 | 53/116 | 68/123 | 83/127 |
| 1999 | 14/67 | 25/ 97 | 38/113 | 53/121 | 69/127 | 84/132 |
| 2000 | 13/66 | 24/ 92 | 36/106 | 50/115 | 65/121 | 79/126 |

Table 3(c) Rms errors of the forecast and persistence for geopotential height at 500 hPa (in metres).

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | -3 | -9 | -13 | -16 | -18 | -21 |
| 1985 | -3 | -8 | -12 | -14 | -16 | -18 |
| 1986 | -4 | -8 | -10 | -12 | -14 | -15 |
| 1987 | -4 | -8 | -11 | -14 | -16 | -19 |
| 1988 | -5 | -10 | -13 | -17 | -20 | -23 |
| 1989 | -4 | -8 | -11 | -13 | -15 | -18 |
| 1990 | -4 | -7 | -10 | -13 | -15 | -18 |
| 1991 | -3 | -5 | -7 | -9 | -10 | -12 |
| 1992 | -6 | -8 | -9 | -9 | -10 | -11 |
| 1993 | -5 | -8 | -10 | -11 | -13 | -14 |
| 1994 | -5 | -8 | -9 | -10 | -11 | -12 |
| 1995 | -1 | -2 | -1 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 1 | 3 | 3 | 3 |
| 1997 | 0 | 0 | 2 | 3 | 3 | 4 |
| 1998 | -1 | -1 | 0 | 1 | 1 | 2 |
| 1999 | -1 | -1 | -1 | 0 | 0 | 0 |
| 2000 | 1 | 1 | 2 | 3 | 3 | 4 |

Table 3(d) Mean errors of the forecast for geopotential height at 500 hPa (in metres).

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | 12/20 | 15/23 | 17/24 | 19/25 | 21/25 | 23/25 |
| 1985 | 12/20 | 14/23 | 16/24 | 19/24 | 20/24 | 21/25 |
| 1986 | 11/20 | 14/23 | 16/24 | 18/25 | 19/25 | 21/25 |
| 1987 | 10/19 | 13/22 | 15/23 | 17/24 | 19/24 | 20/25 |
| 1988 | 9/19 | 12/22 | 15/23 | 16/23 | 18/24 | 20/24 |
| 1989 | 8/18 | 11/21 | 13/22 | 16/23 | 18/23 | 19/24 |
| 1990 | 8/18 | 11/21 | 13/22 | 16/23 | 18/23 | 19/23 |
| 1991 | 7/17 | 10/21 | 13/22 | 16/22 | 18/23 | 20/23 |
| 1992 | 7/17 | 9/20 | 13/21 | 15/22 | 18/22 | 19/23 |
| 1993 | 6/17 | 9/21 | 12/22 | 15/22 | 17/22 | 19/23 |
| 1994 | 6/17 | 9/20 | 12/21 | 15/22 | 19/23 | 19/23 |
| 1995 | 5/16 | 8/20 | 11/21 | 14/22 | 16/22 | 18/22 |
| 1996 | 5/17 | 8/20 | 11/21 | 14/22 | 16/23 | 18/23 |
| 1997 | 5/17 | 8/20 | 11/21 | 14/22 | 16/23 | 18/23 |
| 1998 | 5/17 | 8/20 | 11/21 | 14/22 | 16/22 | 18/22 |
| 1999 | 5/17 | 8/20 | 11/21 | 14/22 | 16/22 | 18/23 |
| 2000 | 5/17 | 8/20 | 10/21 | 13/22 | 16/22 | 18/22 |

Table 3(e) Rms vector wind errors of the forecast and persistence at 850 hPa (in knots).

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | 15/31 | 19/40 | 24/43 | 29/44 | 33/45 | 36/46 |
| 1985 | 15/31 | 19/39 | 23/43 | 28/43 | 31/43 | 34/44 |
| 1986 | 14/32 | 18/40 | 22/42 | 26/44 | 30/45 | 34/46 |
| 1987 | 13/30 | 17/39 | 22/42 | 26/44 | 30/46 | 33/47 |
| 1988 | 12/31 | 17/40 | 21/43 | 26/44 | 30/45 | 33/46 |
| 1989 | 10/29 | 15/38 | 20/41 | 25/44 | 29/45 | 33/46 |
| 1990 | 10/30 | 15/39 | 20/42 | 25/43 | 29/45 | 32/45 |
| 1991 | 10/30 | 15/38 | 21/41 | 26/43 | 30/44 | 34/45 |
| 1992 | 10/29 | 15/37 | 20/41 | 25/42 | 30/43 | 34/44 |
| 1993 | 10/30 | 15/39 | 20/41 | 25/43 | 29/44 | 34/45 |
| 1994 | 10/30 | 15/39 | 20/42 | 25/44 | 30/45 | 35/46 |
| 1995 | 9/30 | 14/39 | 19/42 | 24/44 | 29/45 | 33/46 |
| 1996 | 9/30 | 13/39 | 18/43 | 23/45 | 28/46 | 32/47 |
| 1997 | 8/30 | 13/39 | 18/42 | 23/44 | 28/45 | 32/46 |
| 1998 | 8/31 | 13/39 | 18/42 | 23/44 | 28/45 | 32/46 |
| 1999 | 8/30 | 12/39 | 17/42 | 22/43 | 27/44 | 32/45 |
| 2000 | 8/30 | 12/38 | 16/41 | 21/43 | 26/44 | 30/45 |

Table 3(f) Rms vector wind errors of the forecast and persistence at 200 hPa (in knots). (Also see graph in Figure 6b)

## TABLE 4: ANNUAL MEAN STATISTICS FOR THE TROPICS

## VERIFICATION AGAINST ANALYSES

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | 11/12 | 12/15 | 13/15 | 14/16 | 14/16 | 15/16 |
| 1985 | 10/12 | 12/15 | 13/15 | 14/15 | 14/16 | 14/17 |
| 1986 | 10/12 | 11/15 | 12/16 | 13/16 | 14/16 | 14/16 |
| 1987 | 9/11 | 11/13 | 11/14 | 12/15 | 13/15 | 13/15 |
| 1988 | 9/11 | 10/13 | 11/14 | 12/14 | 12/14 | 13/15 |
| 1989 | 7/ 9 | 9/11 | 10/12 | 11/13 | 12/13 | 12/13 |
| 1990 | 7/ 9 | 9/12 | 10/13 | 11/13 | 12/14 | 12/14 |
| 1991 | 6/ 8 | 8/11 | 10/12 | 11/13 | 11/13 | 12/13 |
| 1992 | 5/ 8 | 7/11 | 9/12 | 10/12 | 11/13 | 12/13 |
| 1993 | 5/ 8 | 7/10 | 8/12 | 9/12 | 10/12 | 11/13 |
| 1994 | 5/ 8 | 7/11 | 8/12 | 9/12 | 10/12 | 11/12 |
| 1995 | 4/ 7 | 6/10 | 7/11 | 9/11 | 9/11 | 10/12 |
| 1996 | 5/ 8 | 6/11 | 8/12 | 9/12 | 10/13 | 11/13 |
| 1997 | 4/ 8 | 6/10 | 7/11 | 8/12 | 9/12 | 10/12 |
| 1998 | 5/ 8 | 6/11 | 8/12 | 9/12 | 10/12 | 10/12 |
| 1999 | 5/ 8 | 6/11 | 7/12 | 8/12 | 9/12 | 10/12 |
| 2000 | 5/ 8 | 6/11 | 7/12 | 8/12 | 8/12 | 10/13 |

Table 4(a) Rms vector wind errors of the forecast and persistence at 850 hPa (in knots). (Also see graph in Figure 7a)

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | 16/21 | 19/27 | 22/29 | 24/30 | 26/31 | 27/31 |
| 1985 | 15/21 | 18/26 | 21/29 | 23/30 | 24/30 | 26/31 |
| 1986 | 14/20 | 18/26 | 20/29 | 22/30 | 23/31 | 25/32 |
| 1987 | 14/19 | 17/25 | 19/28 | 21/29 | 22/30 | 24/30 |
| 1988 | 13/19 | 16/25 | 18/28 | 20/29 | 22/30 | 23/30 |
| 1989 | 11/16 | 14/23 | 17/26 | 19/27 | 21/28 | 23/28 |
| 1990 | 10/16 | 14/23 | 17/26 | 19/28 | 21/29 | 23/29 |
| 1991 | 11/18 | 16/25 | 19/28 | 22/29 | 24/30 | 26/30 |
| 1992 | 10/17 | 15/24 | 18/27 | 21/28 | 24/29 | 26/30 |
| 1993 | 9/17 | 14/24 | 17/27 | 20/28 | 22/29 | 24/30 |
| 1994 | 9/17 | 14/23 | 17/26 | 19/28 | 21/29 | 24/29 |
| 1995 | 9/17 | 13/23 | 17/26 | 19/28 | 22/28 | 24/29 |
| 1996 | 9/18 | 14/25 | 17/28 | 20/29 | 22/30 | 24/31 |
| 1997 | 9/17 | 13/25 | 16/28 | 18/29 | 21/30 | 23/31 |
| 1998 | 9/19 | 13/25 | 16/29 | 18/30 | 21/31 | 23/31 |
| 1999 | 9/18 | 12/24 | 15/27 | 18/29 | 20/29 | 22/30 |
| 2000 | 9/18 | 12/25 | 15/28 | 17/29 | 19/30 | 21/31 |

Table 4(b) Rms vector wind errors of the forecast and persistence at 200 hPa (in knots). (Also see graph in Figure 7b)

## TABLE 5: ANNUAL MEAN STATISTICS FOR THE SOUTHERN HEMISPHERE

## VERIFICATION AGAINST ANALYSES

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | 41/81 | 61/107 | 76/117 | 90/121 | 99/125 | 108/126 |
| 1985 | 40/84 | 58/110 | 73/120 | 85/122 | 96/123 | 105/124 |
| 1986 | 41/85 | 59/112 | 74/123 | 87/130 | 98/135 | 106/138 |
| 1987 | 38/83 | 56/110 | 70/123 | 83/129 | 93/133 | 100/135 |
| 1988 | 36/81 | 54/109 | 68/120 | 80/126 | 90/129 | 98/131 |
| 1989 | 32/84 | 51/111 | 67/121 | 81/128 | 92/132 | 100/132 |
| 1990 | 32/84 | 51/112 | 67/124 | 80/130 | 92/134 | 102/136 |
| 1991 | 32/82 | 52/110 | 69/123 | 83/130 | 95/135 | 106/137 |
| 1992 | 30/81 | 49/109 | 66/121 | 81/127 | 94/132 | 105/134 |
| 1993 | 28/83 | 46/111 | 63/124 | 78/131 | 91/135 | 102/137 |
| 1994 | 28/81 | 46/108 | 62/120 | 77/125 | 91/128 | 102/130 |
| 1995 | 27/80 | 44/108 | 60/120 | 75/126 | 89/130 | 100/132 |
| 1996 | 29/83 | 47/116 | 65/123 | 81/129 | 94/134 | 106/136 |
| 1997 | 30/84 | 48/111 | 65/124 | 81/131 | 94/136 | 106/139 |
| 1998 | 29/88 | 46/115 | 63/126 | 79/132 | 93/135 | 104/136 |
| 1999 | 25/84 | 41/111 | 57/123 | 71/128 | 85/131 | 97/133 |
| 2000 | 20/84 | 35/111 | 49/122 | 65/129 | 80/133 | 94/135 |

Table 5(a) Rms errors of the forecast and persistence for PMSL (in tenths of hPa).
(Also see graph in Figure 8a)

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | 2 | 2 | 3 | 2 | 0 | 0 |
| 1985 | 2 | 4 | 3 | 3 | 3 | 5 |
| 1986 | 3 | 4 | 3 | 4 | 5 | 7 |
| 1987 | 2 | 3 | 3 | 5 | 6 | 9 |
| 1988 | 3 | 4 | 4 | 5 | 7 | 10 |
| 1989 | 2 | 4 | 5 | 7 | 8 | 11 |
| 1990 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1991 | 2 | 3 | 3 | 3 | 4 | 4 |
| 1992 | 3 | 4 | 3 | 4 | 3 | 3 |
| 1993 | 3 | 4 | 4 | 3 | 4 | 4 |
| 1994 | 2 | 2 | 1 | 0 | 0 | 0 |
| 1995 | 3 | 4 | 3 | 3 | 3 | 4 |
| 1996 | 1 | 0 | -1 | -3 | -2 | -2 |
| 1997 | 1 | 1 | 0 | -1 | -1 | -1 |
| 1998 | 1 | 2 | 1 | 1 | 2 | 2 |
| 1999 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2000 | 1 | 1 | 2 | 2 | 2 | 2 |

Table 5(b) Mean errors of the forecast for PMSL (in tenths of hPa).

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | 34/80 | 55/112 | 72/126 | 88/132 | 100/136 | 111/138 |
| 1985 | 32/81 | 52/113 | 69/126 | 85/128 | 97/129 | 108/130 |
| 1986 | 31/82 | 52/114 | 70/129 | 85/138 | 98/144 | 108/147 |
| 1987 | 29/82 | 49/114 | 65/130 | 80/137 | 92/141 | 101/143 |
| 1988 | 29/81 | 48/114 | 65/128 | 80/136 | 92/139 | 102/142 |
| 1989 | 27/86 | 47/118 | 65/132 | 81/140 | 94/145 | 104/145 |
| 1990 | 28/85 | 47/118 | 65/132 | 80/140 | 94/145 | 105/148 |
| 1991 | 27/83 | 48/118 | 67/134 | 84/144 | 99/151 | 111/154 |
| 1992 | 25/84 | 45/118 | 65/134 | 82/142 | 97/147 | 111/150 |
| 1993 | 24/86 | 43/121 | 62/137 | 79/147 | 95/152 | 108/154 |
| 1994 | 24/85 | 43/119 | 61/134 | 78/141 | 93/145 | 107/147 |
| 1995 | 22/85 | 40/117 | 59/133 | 76/141 | 92/146 | 107/149 |
| 1996 | 24/89 | 45/124 | 65/139 | 84/148 | 101/154 | 114/157 |
| 1997 | 24/87 | 44/121 | 63/138 | 81/148 | 98/154 | 112/158 |
| 1998 | 23/90 | 42/122 | 61/136 | 79/145 | 95/149 | 109/152 |
| 1999 | 22/90 | 40/124 | 56/140 | 73/147 | 89/151 | 103/153 |
| 2000 | 19/89 | 33/122 | 49/138 | 66/147 | 83/151 | 99/153 |

Table 5(c) Rms errors of the forecast and persistence for geopotential height at 500 hPa (in metres).

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | -1 | -2 | -3 | -5 | -9 | -10 |
| 1985 | -3 | -7 | -12 | -16 | -20 | -21 |
| 1986 | -2 | -6 | -10 | -14 | -16 | -18 |
| 1987 | -7 | -11 | -15 | -19 | -22 | -23 |
| 1988 | -5 | -11 | -17 | -22 | -26 | -28 |
| 1989 | -4 | -8 | -11 | -15 | -18 | -20 |
| 1990 | -4 | -8 | -13 | -16 | -19 | -21 |
| 1991 | -4 | -8 | -11 | -14 | -17 | -18 |
| 1992 | -4 | -7 | -10 | -12 | -13 | -14 |
| 1993 | -3 | -6 | -9 | -12 | -13 | -13 |
| 1994 | -3 | -6 | -9 | -11 | -11 | -12 |
| 1995 | -1 | -3 | -5 | -6 | -6 | -6 |
| 1996 | -1 | -2 | -4 | -4 | -4 | -3 |
| 1997 | -1 | -1 | -2 | -2 | -1 | 0 |
| 1998 | -1 | -2 | -3 | -4 | -3 | -2 |
| 1999 | -1 | 0 | 0 | 0 | 1 | 2 |
| 2000 | 0 | -1 | -1 | -1 | -1 | 0 |

Table 5(d) Mean errors of the forecast for geopotential height at 500 hPa (in metres).

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | 12/22 | 16/25 | 19/26 | 21/27 | 22/27 | 24/27 |
| 1985 | 12/22 | 16/25 | 19/26 | 21/26 | 22/27 | 23/27 |
| 1986 | 12/22 | 16/26 | 19/27 | 21/28 | 22/28 | 23/29 |
| 1987 | 11/22 | 15/25 | 17/27 | 19/27 | 21/27 | 22/28 |
| 1988 | 11/21 | 14/25 | 17/26 | 19/27 | 20/27 | 21/27 |
| 1989 | 8/21 | 12/25 | 16/26 | 18/26 | 20/27 | 21/26 |
| 1990 | 8/21 | 12/25 | 16/26 | 18/26 | 20/27 | 21/27 |
| 1991 | 8/20 | 12/24 | 16/26 | 19/26 | 21/27 | 23/27 |
| 1992 | 7/20 | 12/24 | 15/25 | 18/26 | 20/26 | 23/26 |
| 1993 | 7/20 | 11/24 | 15/26 | 18/27 | 20/27 | 22/27 |
| 1994 | 7/20 | 12/24 | 15/26 | 18/26 | 21/26 | 22/26 |
| 1995 | 7/20 | 11/24 | 15/25 | 18/26 | 20/26 | 22/26 |
| 1996 | 7/21 | 12/24 | 16/26 | 19/26 | 21/27 | 23/27 |
| 1997 | 7/20 | 12/24 | 16/25 | 19/26 | 21/27 | 23/27 |
| 1998 | 7/21 | 12/25 | 15/26 | 18/26 | 21/27 | 23/27 |
| 1999 | 7/21 | 11/24 | 15/26 | 18/26 | 20/26 | 22/26 |
| 2000 | 6/21 | 10/25 | 14/26 | 17/26 | 19/27 | 22/27 |

Table 5(e) Rms vector wind errors of the forecast and persistence at 850hPa (in knots).

| | T+24 | T+48 | T+72 | T+96 | T+120 | T+144 |
|---|---|---|---|---|---|---|
| 1984 | 14/32 | 20/40 | 25/43 | 30/44 | 33/45 | 36/45 |
| 1985 | 14/33 | 20/41 | 26/43 | 30/44 | 33/44 | 36/44 |
| 1986 | 14/33 | 20/41 | 25/44 | 29/45 | 33/46 | 35/47 |
| 1987 | 14/33 | 20/41 | 24/45 | 29/45 | 32/46 | 35/47 |
| 1988 | 13/33 | 19/42 | 24/46 | 28/47 | 31/47 | 34/47 |
| 1989 | 10/33 | 17/42 | 23/45 | 28/46 | 32/47 | 35/47 |
| 1990 | 11/33 | 17/41 | 23/44 | 28/46 | 31/47 | 34/47 |
| 1991 | 10/32 | 17/41 | 23/45 | 29/46 | 33/48 | 37/48 |
| 1992 | 10/31 | 16/41 | 22/44 | 28/45 | 33/46 | 37/47 |
| 1993 | 10/33 | 16/42 | 22/46 | 28/48 | 33/49 | 37/49 |
| 1994 | 10/33 | 16/43 | 22/46 | 28/47 | 33/48 | 37/48 |
| 1995 | 10/33 | 16/42 | 22/45 | 28/46 | 33/47 | 38/48 |
| 1996 | 9/34 | 16/43 | 23/47 | 29/48 | 34/49 | 38/49 |
| 1997 | 9/33 | 15/42 | 22/46 | 28/48 | 33/49 | 37/49 |
| 1998 | 9/36 | 16/46 | 22/48 | 28/50 | 34/50 | 38/50 |
| 1999 | 9/35 | 15/44 | 20/47 | 26/48 | 31/49 | 35/49 |
| 2000 | 9/35 | 14/44 | 19/47 | 25/48 | 30/49 | 35/49 |

Table 5(f) Rms vector wind errors of the forecast and persistence at 200hPa (in knots). (Also see graph in Figure 8b)

## TABLE 6: VERIFICATION OF PRELIM MODEL PRECIPITATION FORECAST

FORECAST PERIOD 0-6

| FORECAST \ Observed | O | L | M | H | All |
|---|---|---|---|---|---|
| O | 45.9 | 6.3 | 0.5 | 0.0 | 52.8 |
| L | 19.4 | 15.6 | 3.1 | 0.1 | 38.3 |
| M | 1.0 | 3.2 | 3.9 | 0.4 | 8.5 |
| H | 0.0 | 0.0 | 0.2 | 0.2 | 0.4 |
| All | 66.4 | 25.2 | 7.8 | 0.7 | 100.0 |

FORECAST PERIOD 6-12

| FORECAST \ Observed | O | L | M | H | All |
|---|---|---|---|---|---|
| O | 44.6 | 5.0 | 0.7 | 0.0 | 50.4 |
| L | 22.2 | 13.8 | 3.2 | 0.1 | 39.3 |
| M | 1.5 | 3.5 | 4.1 | 0.4 | 9.5 |
| H | 0.0 | 0.1 | 0.4 | 0.3 | 0.8 |
| All | 68.3 | 22.5 | 8.4 | 0.8 | 100.0 |

FORECAST PERIOD 12-18

| FORECAST \ Observed | O | L | M | H | All |
|---|---|---|---|---|---|
| O | 46.1 | 6.8 | 0.9 | 0.1 | 53.9 |
| L | 19.3 | 14.0 | 3.1 | 0.1 | 36.6 |
| M | 0.9 | 3.8 | 3.6 | 0.5 | 8.9 |
| H | 0.0 | 0.1 | 0.3 | 0.2 | 0.6 |
| All | 66.4 | 24.7 | 8.0 | 0.9 | 100.0 |

FORECAST PERIOD 18-24

| FORECAST \ Observed | O | L | M | H | All |
|---|---|---|---|---|---|
| O | 42.7 | 7.0 | 1.0 | 0.1 | 50.7 |
| L | 22.8 | 13.7 | 3.1 | 0.1 | 39.7 |
| M | 1.6 | 3.5 | 3.5 | 0.4 | 9.0 |
| H | 0.0 | 0.1 | 0.3 | 0.2 | 0.6 |
| All | 67.1 | 24.3 | 7.8 | 0.8 | 100.0 |

FORECAST PERIOD 24-30

| FORECAST \ Observed | O | L | M | H | All |
|---|---|---|---|---|---|
| O | 37.8 | 6.3 | 0.8 | 0.1 | 45.0 |
| L | 26.7 | 14.9 | 3.5 | 0.2 | 45.4 |
| M | 1.8 | 3.8 | 3.3 | 0.3 | 9.2 |
| H | 0.0 | 0.2 | 0.2 | 0.1 | 0.5 |
| All | 66.4 | 25.2 | 7.8 | 0.7 | 100.0 |

Table 6 UK area. Contingency tables for 2000 with frequencies averaged over selected reporting stations and expressed as percentages (06Z run data).
Key to precipitation classes:-
"O" = Nil pptn (less than 0.1 mm), "L" = Light (between 0.1 & 2.4 mm)
"M" = Moderate (between 2.4 & 10.4 mm), "H" = Heavy (10.4 mm or more)

## TABLE 7: PRELIM/LIMITED AREA MODEL PRECIPITATION ANNUAL FORECAST SCORES

| | FORECAST PERIOD | | | | |
|---|---|---|---|---|---|
| | 0-6 | 6-12 | 12-18 | 18-24 | 24-30 |
| 1988 | 77.9 | 77.0 | 74.7 | 74.5 | 72.4 |
| 1989 | 80.6 | 79.7 | 77.9 | 77.4 | 77.4 |
| 1990 | 79.2 | 78.6 | 76.9 | 76.3 | 75.2 |
| 1991 | 80.6 | 79.5 | 77.0 | 75.8 | 73.7 |
| 1992 | 80.6 | 79.2 | 76.6 | 74.4 | 72.1 |
| 1993 | 80.9 | 79.4 | 75.7 | 74.4 | 71.6 |
| 1994 | 79.9 | 78.7 | 74.5 | 74.4 | 71.2 |
| 1995 | 79.0 | 78.6 | 76.1 | 76.2 | 73.8 |
| 1996 | 76.3 | 75.8 | 72.9 | 72.9 | 70.9 |
| 1997 | 75.3 | 75.5 | 72.6 | 73.0 | 71.0 |
| 1998 | 72.1 | 69.2 | 71.3 | 68.1 | 65.4 |
| 1999 | 74.9 | 72.0 | 72.0 | 69.1 | 67.5 |
| 2000 | 72.7 | 70.5 | 72.0 | 67.6 | 64.3 |

Table 7(a) Percentage Correct, UK area. Percentage of events correctly forecast, based on Rain/No Rain criterion, as in Table 6.
NB:From 1998 results are for the 06Z run forecast. Results prior to this are for combined 00Z and 12Z run forecasts.

| | FORECAST PERIOD | | | | |
|---|---|---|---|---|---|
| | 0-6 | 6-12 | 12-18 | 18-24 | 24-30 |
| 1988 | 1.0 | 1.1 | 1.2 | 1.2 | 1.3 |
| 1989 | 1.0 | 1.1 | 1.2 | 1.2 | 1.3 |
| 1990 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 |
| 1991 | 0.9 | 1.1 | 1.2 | 1.3 | 1.3 |
| 1992 | 0.9 | 1.1 | 1.3 | 1.3 | 1.4 |
| 1993 | 1.0 | 1.2 | 1.4 | 1.4 | 1.6 |
| 1994 | 1.1 | 1.3 | 1.5 | 1.5 | 1.6 |
| 1995 | 1.3 | 1.3 | 1.5 | 1.4 | 1.5 |
| 1996 | 1.5 | 1.5 | 1.7 | 1.6 | 1.7 |
| 1997 | 1.6 | 1.6 | 1.7 | 1.6 | 1.7 |
| 1998 | 1.5 | 1.7 | 1.5 | 1.6 | 1.7 |
| 1999 | 1.4 | 1.6 | 1.4 | 1.5 | 1.6 |
| 2000 | 1.4 | 1.6 | 1.4 | 1.5 | 1.6 |

Table 7(b) Bias, UK area. Number of occasions on which rain was forecast as a ratio of the number of occasions on which rain was observed, as in Table 6.
NB:From 1998 results are for the 06Z run forecast. Results prior to this are for combined 00Z and 12Z run forecasts.

## TABLE 8: VERIFICATION OF MESOSCALE MODEL PRECIPITATION FORECAST

FORECAST PERIOD 0-6

| FORECAST \ Observed | O | L | M | H | All |
|---|---|---|---|---|---|
| O | 47.1 | 5.6 | 0.3 | 0.0 | 53.0 |
| L | 18.1 | 15.8 | 2.4 | 0.0 | 36.4 |
| M | 1.3 | 3.7 | 4.7 | 0.4 | 9.9 |
| H | 0.0 | 0.1 | 0.4 | 0.2 | 0.7 |
| All | 66.5 | 25.1 | 7.8 | 0.6 | 100.0 |

FORECAST PERIOD 6-12

| FORECAST \ Observed | O | L | M | H | All |
|---|---|---|---|---|---|
| O | 45.8 | 4.4 | 0.4 | 0.0 | 50.7 |
| L | 20.0 | 13.5 | 2.9 | 0.1 | 36.4 |
| M | 2.2 | 4.6 | 4.7 | 0.4 | 11.8 |
| H | 0.1 | 0.1 | 0.5 | 0.3 | 1.1 |
| All | 68.1 | 22.6 | 8.4 | 0.8 | 100.0 |

FORECAST PERIOD 12-18

| FORECAST \ Observed | O | L | M | H | All |
|---|---|---|---|---|---|
| O | 50.4 | 7.5 | 0.6 | 0.0 | 58.6 |
| L | 14.7 | 12.9 | 2.9 | 0.1 | 30.6 |
| M | 1.3 | 4.1 | 3.8 | 0.6 | 9.7 |
| H | 0.1 | 0.2 | 0.5 | 0.3 | 1.0 |
| All | 66.5 | 24.7 | 7.8 | 1.0 | 100.0 |

FORECAST PERIOD 18-24

| FORECAST \ Observed | O | L | M | H | All |
|---|---|---|---|---|---|
| O | 50.0 | 8.6 | 0.9 | 0.0 | 59.6 |
| L | 15.4 | 11.7 | 3.0 | 0.1 | 30.3 |
| M | 1.9 | 3.5 | 3.4 | 0.3 | 9.1 |
| H | 0.1 | 0.2 | 0.5 | 0.3 | 1.1 |
| All | 67.4 | 24.0 | 7.8 | 0.8 | 100.0 |

FORECAST PERIOD 24-30

| FORECAST \ Observed | O | L | M | H | All |
|---|---|---|---|---|---|
| O | 45.6 | 7.7 | 0.7 | 0.0 | 54.1 |
| L | 18.4 | 13.0 | 3.0 | 0.2 | 34.5 |
| M | 2.4 | 4.3 | 3.7 | 0.3 | 10.6 |
| H | 0.1 | 0.2 | 0.4 | 0.1 | 0.8 |
| All | 66.5 | 25.1 | 7.8 | 0.6 | 100.0 |

Table 8 UK area. Contingency tables for 2000 with frequencies averaged over selected reporting stations and expressed as percentages (06Z run data).
Key to precipitation classes:-
"O" = Nil pptn (less than 0.1 mm), "L" = Light (between 0.1 & 2.4 mm)
"M" = Moderate (between 2.4 & 10.4 mm), "H" = Heavy (10.4 mm or more)

TABLE 9: ANNUAL MEAN STATISTICS FOR THE UK MESOSCALE MODEL

VERIFICATION AGAINST OBSERVATIONS

| | FORECAST PERIOD | | | | |
|---|---|---|---|---|---|
| | 0-6 | 6-12 | 12-18 | 18-24 | 24-30 |
| 1993 | 79.3 | 76.6 | 77.2 | 75.0 | 72.9 |
| 1994 | 78.5 | 75.0 | 74.6 | 70.7 | 71.3 |
| 1995 | 79.0 | 76.1 | 77.1 | 74.7 | 73.8 |
| 1996 | 78.0 | 73.9 | 72.9 | 68.9 | 68.5 |
| 1997 | 79.9 | 75.7 | 74.6 | 69.8 | 70.1 |
| 1998 | 76.7 | 73.1 | 74.1 | 70.1 | 70.0 |
| 1999 | 75.3 | 73.3 | 75.3 | 73.3 | 72.3 |
| 2000 | 74.7 | 72.9 | 75.7 | 72.9 | 70.7 |

Table 9(a) Precipitation: Percentage Correct. Percentage of events correctly forecast, based on Rain/No Rain criterion, as in Table 8 (06Z run data).

| | FORECAST PERIOD | | | | |
|---|---|---|---|---|---|
| | 0-6 | 6-12 | 12-18 | 18-24 | 24-30 |
| 1993 | 1.04 | 1.40 | 1.19 | 1.33 | 1.36 |
| 1994 | 1.09 | 1.43 | 1.36 | 1.48 | 1.42 |
| 1995 | 1.18 | 1.48 | 1.32 | 1.41 | 1.37 |
| 1996 | 1.32 | 1.69 | 1.63 | 1.75 | 1.59 |
| 1997 | 1.26 | 1.62 | 1.60 | 1.80 | 1.63 |
| 1998 | 1.29 | 1.54 | 1.41 | 1.53 | 1.48 |
| 1999 | 1.45 | 1.60 | 1.37 | 1.33 | 1.39 |
| 2000 | 1.40 | 1.55 | 1.23 | 1.24 | 1.37 |

Table 9(b) Precipitation: Bias. Number of occasions on which rain was forecast as a ratio of the number of occasions on which rain was observed, as in Table 8 (06Z run data).

| | MEAN ERROR (SURF) | | | | RMS ERROR (SURF) | | | |
|---|---|---|---|---|---|---|---|---|
| | T+6 | T+12 | T+18 | T+24 | T+6 | T+12 | T+18 | T+24 |
| 1993 | -0.31 | -0.27 | -0.04 | 0.18 | 1.83 | 1.68 | 1.68 | 1.80 |
| 1994 | -0.63 | -0.42 | 0.17 | 0.30 | 1.83 | 1.74 | 1.68 | 1.71 |
| 1995 | 0.03 | 0.28 | 0.68 | 0.76 | 1.75 | 1.68 | 1.83 | 1.99 |
| 1996 | -0.17 | 0.09 | 0.55 | 0.57 | 1.68 | 1.60 | 1.76 | 1.86 |
| 1997 | -0.27 | -0.01 | 0.44 | 0.50 | 1.66 | 1.52 | 1.66 | 1.79 |
| 1998 | -0.40 | -0.14 | 0.27 | 0.30 | 1.58 | 1.51 | 1.55 | 1.63 |
| 1999 | -0.29 | -0.04 | 0.27 | 0.23 | 1.46 | 1.37 | 1.55 | 1.62 |
| 2000 | -0.08 | 0.05 | 0.13 | 0.01 | 1.32 | 1.35 | 1.53 | 1.77 |

Table 9(c) Mean and Rms errors of 1.5m temperature forecasts (in degrees K) from the Mesoscale Model (06Z run data).

| | MEAN ERROR | | | | RMS ERROR | | | |
|---|---|---|---|---|---|---|---|---|
| | T+6 | T+12 | T+18 | T+24 | T+6 | T+12 | T+18 | T+24 |
| 1993 | -0.79 | -0.48 | 0.11 | 0.03 | 2.73 | 2.80 | 2.93 | 2.81 |
| 1994 | -0.01 | 0.57 | 1.17 | 0.88 | 2.33 | 2.53 | 3.00 | 2.81 |
| 1995 | -0.42 | -0.13 | 0.43 | 0.11 | 2.34 | 2.43 | 2.89 | 2.76 |
| 1996 | -0.87 | -0.16 | 0.31 | 0.10 | 2.41 | 2.46 | 2.74 | 2.63 |
| 1997 | -0.57 | -0.21 | 0.32 | 0.00 | 2.40 | 2.44 | 2.78 | 2.62 |
| 1998 | -0.54 | -0.16 | 0.20 | -0.01 | 2.31 | 2.39 | 2.64 | 2.47 |
| 1999 | -1.05 | -0.73 | -0.38 | -0.52 | 2.48 | 2.53 | 2.70 | 2.68 |
| 2000 | -0.94 | -0.71 | -0.32 | -0.27 | 2.42 | 2.50 | 2.65 | 2.61 |

Table 9(d) Mean and Rms errors of total cloud amount forecasts (in oktas) from the Mesoscale Model (06Z run data).

| | MEAN SPEED ERROR (SURF) | | | | RMS VECTOR WIND ERROR (SURF) | | | |
|---|---|---|---|---|---|---|---|---|
| | T+6 | T+12 | T+18 | T+24 | T+6 | T+12 | T+18 | T+24 |
| 1993 | -1.30 | -0.23 | 0.84 | 0.74 | 6.49 | 6.53 | 6.55 | 6.85 |
| 1994 | -1.71 | -0.62 | 0.21 | 0.25 | 6.74 | 6.74 | 6.95 | 7.25 |
| 1995 | -1.60 | -0.45 | 0.44 | 0.44 | 5.47 | 5.76 | 5.92 | 6.09 |
| 1996 | -1.54 | -0.40 | 0.56 | 0.59 | 5.28 | 5.34 | 5.54 | 5.83 |
| 1997 | -1.38 | -0.32 | 0.56 | 0.57 | 5.10 | 5.10 | 5.34 | 5.68 |
| 1998 | -1.51 | -0.37 | 0.49 | 0.44 | 5.18 | 5.28 | 5.35 | 5.69 |
| 1999 | -1.11 | -0.12 | 0.72 | 0.63 | 5.13 | 5.12 | 5.30 | 5.57 |
| 2000 | -1.08 | -0.43 | 0.20 | 0.19 | 4.99 | 5.05 | 5.21 | 5.66 |

Table 9(e) Mean speed and Rms vector wind errors of 10m wind forecasts (in knots) from the Mesoscale Model (06Z run data).

## TABLE 10: 48-POINT VERIFICATION SCHEME

(Also see graphs in Figures 9a to 9d)

| Year | Rms Ht Error | Rms Vector Wind Error | Ht Change Corr | Stretch Vector Corr | Ht/Ht Error Corr | F/C-Actual K.E. Equiv Wind | Rms F/C Ht Chge | Mean Ht Error | Rms Actual Wind |
|---|---|---|---|---|---|---|---|---|---|
| 1957 | 45 | 16 | 0.67 | 0.63 | -0.18 | 3 | 53 | -8 | 24 |
| 1958 | 44 | 16 | 0.67 | 0.64 | -0.18 | 5 | 55 | -12 | 23 |
| 1959 | 46 | 17 | 0.67 | 0.67 | -0.20 | -4 | 57 | -12 | 24 |
| 1960 | 43 | 16 | 0.67 | 0.66 | -0.24 | -4 | 51 | -11 | 23 |
| 1961 | 45 | 17 | 0.66 | 0.62 | -0.26 | -5 | 53 | -10 | 24 |
| 1962 | 45 | 17 | 0.70 | 0.65 | -0.25 | -7 | 59 | -8 | 24 |
| 1963 | 43 | 16 | 0.70 | 0.66 | -0.19 | -4 | 53 | -10 | 24 |
| 1964 | 42 | 15 | 0.70 | 0.65 | -0.22 | -3 | 54 | -8 | 23 |
| 1965 | 44 | 16 | 0.71 | 0.66 | -0.21 | -5 | 59 | -8 | 23 |
| 1966 | 44 | 16 | 0.69 | 0.65 | -0.21 | -5 | 57 | -9 | 24 |
| 1967 | 44 | 16 | 0.72 | 0.67 | -0.26 | -7 | 55 | -9 | 25 |
| 1968 | 43 | 15 | 0.67 | 0.67 | -0.26 | -6 | 48 | -11 | 23 |
| 1969 | 42 | 15 | 0.69 | 0.66 | -0.22 | -4 | 51 | -10 | 23 |
| 1970 | 42 | 16 | 0.70 | 0.63 | -0.20 | -4 | 55 | -9 | 24 |
| 1971 | 43 | 16 | 0.66 | 0.64 | -0.26 | -5 | 53 | -5 | 22 |
| 1972 | 43 | 16 | 0.66 | 0.67 | -0.26 | -5 | 56 | -5 | 24 |
| 1973 | 42 | 16 | 0.70 | 0.63 | -0.21 | 3 | 60 | -5 | 23 |
| 1974 | 43 | 17 | 0.68 | 0.64 | -0.27 | -8 | 57 | -5 | 25 |
| 1975 | 38 | 14 | 0.74 | 0.69 | -0.26 | -7 | 55 | -7 | 23 |
| 1976 | 39 | 14 | 0.73 | 0.69 | -0.26 | -8 | 53 | -6 | 23 |
| 1977 | 35 | 13 | 0.79 | 0.74 | -0.25 | -8 | 58 | -5 | 24 |
| 1978 | 33 | 13 | 0.79 | 0.75 | -0.21 | -7 | 56 | -4 | 24 |
| 1979 | 35 | 13 | 0.82 | 0.74 | -0.14 | -9 | 63 | -8 | 24 |
| 1980 | 32 | 12 | 0.84 | 0.77 | -0.19 | -5 | 61 | -11 | 23 |
| 1981 | 33 | 13 | 0.83 | 0.74 | -0.21 | -7 | 62 | -9 | 24 |
| 1982 | 32 | 13 | 0.84 | 0.77 | -0.11 | -4 | 63 | -6 | 25 |
| 1983 | 28 | 11 | 0.87 | 0.81 | -0.07 | 1 | 67 | -9 | 25 |
| 1984 | 27 | 11 | 0.86 | 0.80 | -0.05 | 4 | 59 | -8 | 23 |
| 1985 | 27 | 11 | 0.87 | 0.81 | -0.05 | 5 | 56 | -9 | 23 |
| 1986 | 29 | 12 | 0.88 | 0.82 | -0.00 | 7 | 69 | -13 | 26 |
| 1987 | 23 | 10 | 0.90 | 0.83 | -0.01 | 5 | 60 | -5 | 22 |
| 1988 | 22 | 10 | 0.90 | 0.85 | -0.08 | 2 | 62 | -4 | 24 |
| 1989 | 24 | 11 | 0.90 | 0.83 | 0.00 | 4 | 60 | -7 | 24 |
| 1990 | 22 | 10 | 0.91 | 0.84 | -0.03 | 2 | 61 | -7 | 25 |
| 1991 | 22 | 10 | 0.91 | 0.85 | 0.04 | 6 | 63 | -5 | 24 |
| 1992 | 23 | 11 | 0.91 | 0.82 | 0.05 | 7 | 68 | -2 | 24 |
| 1993 | 20 | 10 | 0.92 | 0.84 | 0.07 | 7 | 62 | -2 | 24 |
| 1994 | 20 | 11 | 0.93 | 0.86 | 0.08 | 8 | 60 | -3 | 25 |
| 1995 | 19 | 10 | 0.93 | 0.84 | -0.07 | 4 | 62 | 2 | 24 |
| 1996 | 18 | 10 | 0.92 | 0.86 | 0.01 | 3 | 60 | 3 | 23 |
| 1997 | 19 | 10 | 0.91 | 0.85 | -0.03 | 2 | 60 | 5 | 23 |
| 1998 | 18 | 10 | 0.94 | 0.87 | -0.09 | 0 | 62 | 5 | 24 |
| 1999 | 17 | 10 | 0.94 | 0.87 | -0.07 | 1 | 60 | 3 | 24 |
| 2000 | 13 | 7 | 0.96 | 0.93 | 0.09 | 5 | 61 | 1 | 24 |

Table 10(a) NMC T+24: Verification of NMC's 24-hour forecast of the geopotential height (in metres) and geostrophic wind (in knots) at 1000 hPa, valid at 00Z.

| Year | Rms Ht Error | Rms Vector Wind Error | Ht Change Corr | Stretch Vector Corr | Ht/Ht Error Corr | F/C-Actual K.E. Equiv | Rms F/C Ht Chge | Mean Ht Error | Rms Actual Wind |
|---|---|---|---|---|---|---|---|---|---|
| 1980 | 28 | 10 | 0.88 | 0.82 | -0.25 | -8 | 62 | -9 | 23 |
| 1981 | 29 | 12 | 0.87 | 0.80 | -0.28 | -10 | 62 | -8 | 24 |
| 1982 | 29 | 12 | 0.87 | 0.80 | -0.20 | -6 | 64 | -5 | 25 |
| 1983 | 27 | 11 | 0.89 | 0.83 | -0.01 | 7 | 68 | -9 | 25 |
| 1984 | 27 | 11 | 0.89 | 0.82 | 0.03 | 6 | 63 | -10 | 23 |
| 1985 | 25 | 10 | 0.90 | 0.85 | 0.03 | 7 | 61 | -13 | 23 |
| 1986 | 28 | 11 | 0.91 | 0.85 | 0.06 | 8 | 73 | -15 | 26 |
| 1987 | 23 | 10 | 0.92 | 0.85 | -0.01 | 5 | 62 | -3 | 22 |
| 1988 | 20 | 10 | 0.92 | 0.87 | -0.06 | 0 | 63 | -4 | 24 |
| 1989 | 21 | 10 | 0.92 | 0.86 | -0.01 | 3 | 59 | -7 | 24 |
| 1990 | 19 | 9 | 0.93 | 0.86 | -0.04 | 1 | 61 | -7 | 25 |
| 1991 | 19 | 9 | 0.93 | 0.87 | 0.06 | 5 | 63 | -5 | 24 |
| 1992 | 20 | 10 | 0.93 | 0.87 | 0.10 | 6 | 66 | -1 | 24 |
| 1993 | 18 | 9 | 0.94 | 0.88 | 0.13 | 8 | 70 | -1 | 24 |
| 1994 | 19 | 9 | 0.94 | 0.88 | 0.21 | 8 | 71 | -2 | 25 |
| 1995 | 17 | 9 | 0.95 | 0.88 | -0.03 | 2 | 69 | 4 | 24 |
| 1996 | 17 | 9 | 0.93 | 0.89 | 0.04 | 3 | 61 | 4 | 23 |
| 1997 | 18 | 9 | 0.93 | 0.88 | -0.01 | 2 | 60 | 6 | 23 |
| 1998 | 17 | 9 | 0.95 | 0.88 | -0.03 | 1 | 62 | 6 | 24 |
| 1999 | 16 | 9 | 0.95 | 0.89 | -0.03 | 1 | 61 | 4 | 24 |
| 2000 | 13 | 7 | 0.96 | 0.93 | 0.05 | 4 | 61 | 2 | 24 |

Table 10(b) Limited Area T+24: Verification of the Limited Area Model 24-hour forecast of the geopotential height (in metres) and geostrophic wind (in knots) at 1000 hPa, valid at 00Z.

| Year | Rms Ht Error | Rms Vector Wind Error | Ht Change Corr | Stretch Vector Corr | Ht/Ht Error Corr | F/C-Actual K.E. Equiv Wind | Rms F/C Ht Chge | Mean Ht Error | Rms Actual Wind |
|---|---|---|---|---|---|---|---|---|---|
| 1968 | 37 | 13 | 0.77 | 0.72 | -0.43 | -11 | 47 | -14 | 23 |
| 1969 | 37 | 13 | 0.79 | 0.73 | -0.43 | -11 | 49 | -14 | 23 |
| 1970 | 38 | 13 | 0.80 | 0.71 | -0.36 | -11 | 53 | -16 | 24 |
| 1971 | 38 | 13 | 0.78 | 0.73 | -0.40 | -11 | 50 | -16 | 22 |
| 1972 | 36 | 13 | 0.77 | 0.73 | -0.41 | -11 | 50 | -10 | 24 |
| 1973 | 33 | 12 | 0.82 | 0.74 | -0.44 | -10 | 58 | -12 | 23 |
| 1974 | 36 | 14 | 0.80 | 0.74 | -0.43 | -13 | 57 | -2 | 25 |
| 1975 | 32 | 13 | 0.82 | 0.74 | -0.29 | -9 | 55 | -9 | 23 |
| 1976 | 33 | 12 | 0.81 | 0.74 | -0.38 | -11 | 52 | -4 | 23 |
| 1977 | 29 | 12 | 0.84 | 0.78 | -0.40 | -12 | 56 | 2 | 24 |
| 1978 | 28 | 11 | 0.85 | 0.82 | -0.42 | -11 | 54 | 4 | 24 |
| 1979 | 27 | 11 | 0.87 | 0.80 | -0.40 | -12 | 59 | 3 | 24 |
| 1980 | 24 | 10 | 0.88 | 0.82 | -0.44 | -12 | 57 | 0 | 23 |
| 1981 | 26 | 12 | 0.87 | 0.80 | -0.45 | -12 | 57 | 0 | 24 |
| 1982 | 26 | 11 | 0.88 | 0.81 | -0.39 | -12 | 61 | 2 | 25 |
| 1983 | 22 | 10 | 0.91 | 0.85 | -0.16 | -6 | 65 | -3 | 25 |
| 1984 | 22 | 10 | 0.89 | 0.84 | -0.02 | 3 | 60 | -1 | 23 |
| 1985 | 20 | 9 | 0.91 | 0.86 | -0.08 | 4 | 56 | 3 | 23 |
| 1986 | 22 | 10 | 0.91 | 0.85 | -0.03 | 5 | 59 | 0 | 26 |
| 1987 | 19 | 9 | 0.92 | 0.85 | -0.06 | 4 | 60 | 1 | 26 |
| 1988 | 20 | 10 | 0.92 | 0.87 | -0.13 | -3 | 61 | 3 | 24 |
| 1989 | 19 | 9 | 0.92 | 0.86 | -0.06 | -3 | 58 | 2 | 24 |
| 1990 | 19 | 9 | 0.95 | 0.86 | -0.08 | -3 | 59 | 2 | 25 |
| 1991 | 17 | 9 | 0.93 | 0.87 | -0.01 | 0 | 63 | 0 | 24 |
| 1992 | 18 | 9 | 0.94 | 0.87 | 0.00 | -1 | 63 | 0 | 24 |
| 1993 | 17 | 9 | 0.94 | 0.88 | 0.06 | 4 | 59 | 0 | 23 |
| 1994 | 18 | 9 | 0.94 | 0.89 | 0.10 | 5 | 59 | -1 | 25 |
| 1995 | 15 | 8 | 0.95 | 0.89 | -0.08 | -1 | 61 | 4 | 24 |
| 1996 | 16 | 8 | 0.94 | 0.89 | -0.06 | 0 | 60 | 4 | 23 |
| 1997 | 17 | 9 | 0.93 | 0.88 | -0.10 | -1 | 59 | 5 | 23 |
| 1998 | 16 | 9 | 0.95 | 0.88 | -0.06 | 0 | 61 | 5 | 24 |
| 1999 | 16 | 9 | 0.95 | 0.89 | -0.04 | 0 | 61 | 4 | 24 |
| 2000 | 13 | 7 | 0.96 | 0.93 | 0.04 | 4 | 61 | 1 | 24 |

Table 10(c) Global T+24: Verification of the Global Model 24-hour forecast of the geopotential height (in metres) and geostrophic wind (in knots) at 1000 hPa, valid at 00Z.

| Year | Rms Ht Error | Ht Vector Wind Error | Ht Change Corr | Stretch Vector Corr | Ht/Ht Error Corr | F/C-Actual K.E. Equiv | Rms F/C Ht Chge | Mean Ht Error | Rms Actual Wind |
|---|---|---|---|---|---|---|---|---|---|
| 1969 | 66 | 18 | 0.50 | 0.52 | -0.49 | -11 | 60 | -35 | 23 |
| 1970 | 67 | 19 | 0.52 | 0.49 | -0.49 | -11 | 64 | -37 | 24 |
| 1977 | 67 | 18 | 0.48 | 0.49 | -0.48 | -11 | 61 | -36 | 22 |
| 1972 | 60 | 18 | 0.49 | 0.55 | -0.48 | -12 | 54 | -21 | 24 |
| 1973 | 57 | 18 | 0.74 | 0.52 | -0.50 | -11 | 84 | -20 | 23 |
| 1974 | 60 | 19 | 0.70 | 0.50 | -0.52 | -14 | 79 | -4 | 25 |
| 1975 | 55 | 18 | 0.73 | 0.52 | -0.41 | -10 | 80 | -17 | 23 |
| 1976 | 59 | 17 | 0.72 | 0.52 | -0.48 | -13 | 77 | -13 | 23 |
| 1977 | 51 | 16 | 0.78 | 0.59 | -0.49 | -14 | 81 | -13 | 24 |
| 1978 | 45 | 15 | 0.79 | 0.66 | -0.47 | -13 | 74 | -3 | 24 |
| 1979 | 45 | 16 | 0.81 | 0.57 | -0.44 | -14 | 83 | -4 | 24 |
| 1980 | 43 | 15 | 0.83 | 0.66 | -0.47 | -13 | 81 | -13 | 23 |
| 1981 | 46 | 16 | 0.81 | 0.62 | -0.50 | -15 | 78 | -12 | 24 |
| 1982 | 41 | 15 | 0.83 | 0.66 | -0.38 | -12 | 84 | 5 | 25 |
| 1983 | 34 | 13 | 0.89 | 0.76 | -0.13 | -4 | 90 | -8 | 25 |
| 1984 | 35 | 14 | 0.86 | 0.74 | -0.01 | 6 | 81 | -5 | 23 |
| 1985 | 32 | 14 | 0.87 | 0.74 | -0.16 | 4 | 77 | 0 | 23 |
| 1986 | 34 | 14 | 0.87 | 0.74 | -0.09 | 6 | 88 | -2 | 26 |
| 1987 | 32 | 13 | 0.88 | 0.73 | -0.11 | 4 | 83 | -1 | 22 |
| 1988 | 31 | 13 | 0.89 | 0.77 | -0.15 | -3 | 78 | 1 | 24 |
| 1989 | 29 | 13 | 0.87 | 0.76 | -0.10 | 0 | 79 | 1 | 24 |
| 1990 | 31 | 13 | 0.87 | 0.76 | -0.14 | -4 | 81 | 3 | 25 |
| 1991 | 29 | 12 | 0.90 | 0.77 | -0.06 | 2 | 85 | -1 | 24 |
| 1992 | 29 | 12 | 0.91 | 0.77 | -0.04 | 3 | 86 | 2 | 24 |
| 1993 | 27 | 12 | 0.92 | 0.80 | 0.02 | 3 | 82 | -1 | 24 |
| 1994 | 31 | 13 | 0.91 | 0.80 | 0.09 | 9 | 89 | -5 | 25 |
| 1995 | 25 | 11 | 0.93 | 0.80 | -0.08 | 0 | 87 | 4 | 24 |
| 1996 | 26 | 11 | 0.92 | 0.82 | -0.10 | 0 | 84 | 6 | 23 |
| 1997 | 26 | 11 | 0.93 | 0.81 | -0.15 | -1 | 84 | 9 | 23 |
| 1998 | 25 | 12 | 0.93 | 0.81 | -0.07 | 1 | 85 | 5 | 24 |
| 1999 | 22 | 11 | 0.94 | 0.82 | -0.06 | 1 | 87 | 5 | 24 |
| 2000 | 21 | 10 | 0.95 | 0.86 | -0.01 | 4 | 83 | 3 | 24 |

Table 10(d) Global T+48: Verification of the Global Model 48-hour forecast of the geopotential height (in metres) and geostrophic wind (in knots) at 1000 hPa, valid at 00Z.

| Year | Rms Ht Error | Rms Vector Wind Error | Ht Change Corr | Stretch Vector Corr | Ht/Ht Error Corr | F/C-Actual K.E. Equiv Wind | Rms F/C Ht Chge | Mean Ht Error | Rms Actual Wind |
|---|---|---|---|---|---|---|---|---|---|
| 1969 | 88 | 21 | 0.33 | 0.37 | -0.55 | -12 | 78 | -50 | 23 |
| 1970 | 92 | 22 | 0.33 | 0.30 | -0.50 | -11 | 84 | -54 | 24 |
| 1971 | 93 | 22 | 0.31 | 0.30 | -0.57 | -12 | 83 | -53 | 22 |
| 1972 | 80 | 22 | 0.32 | 0.40 | -0.53 | -13 | 69 | -28 | 24 |
| 1973 | 78 | 22 | 0.65 | 0.36 | -0.54 | -11 | 98 | -23 | 23 |
| 1974 | 78 | 23 | 0.62 | 0.31 | -0.58 | -15 | 92 | -4 | 25 |
| 1975 | 76 | 22 | 0.65 | 0.37 | -0.47 | -9 | 97 | -21 | 23 |
| 1976 | 77 | 20 | 0.65 | 0.37 | -0.54 | -13 | 93 | -20 | 23 |
| 1977 | 67 | 19 | 0.72 | 0.44 | -0.58 | -16 | 95 | -22 | 24 |
| 1978 | 58 | 18 | 0.71 | 0.49 | -0.54 | -15 | 84 | 0 | 24 |
| 1979 | 61 | 19 | 0.74 | 0.47 | -0.50 | -15 | 95 | 2 | 24 |
| 1980 | 58 | 18 | 0.78 | 0.52 | -0.53 | -14 | 89 | -10 | 23 |
| 1981 | 60 | 19 | 0.74 | 0.47 | -0.56 | -16 | 87 | -7 | 24 |
| 1982 | 55 | 18 | 0.78 | 0.53 | -0.42 | -12 | 96 | -3 | 25 |
| 1983 | 48 | 16 | 0.83 | 0.65 | -0.17 | 3 | 103 | -12 | 25 |
| 1984 | 48 | 17 | 0.79 | 0.62 | -0.09 | 7 | 100 | -11 | 23 |
| 1985 | 46 | 17 | 0.80 | 0.61 | -0.22 | 6 | 89 | 1 | 23 |
| 1986 | 45 | 17 | 0.83 | 0.63 | -0.20 | 8 | 97 | 0 | 26 |
| 1987 | 44 | 16 | 0.83 | 0.62 | -0.21 | 5 | 95 | 1 | 22 |
| 1988 | 44 | 19 | 0.84 | 0.65 | -0.26 | -6 | 99 | 3 | 24 |
| 1989 | 38 | 16 | 0.83 | 0.59 | -0.16 | -2 | 93 | 2 | 24 |
| 1990 | 44 | 16 | 0.84 | 0.58 | -0.21 | -5 | 93 | 4 | 25 |
| 1991 | 43 | 16 | 0.85 | 0.64 | -0.15 | 1 | 98 | -1 | 24 |
| 1992 | 41 | 16 | 0.85 | 0.65 | -0.14 | 0 | 96 | 3 | 24 |
| 1993 | 40 | 15 | 0.87 | 0.68 | -0.07 | 3 | 95 | -3 | 24 |
| 1994 | 43 | 16 | 0.87 | 0.69 | 0.03 | 9 | 101 | -5 | 25 |
| 1995 | 36 | 15 | 0.88 | 0.68 | -0.17 | 0 | 101 | 5 | 24 |
| 1996 | 36 | 14 | 0.89 | 0.72 | -0.19 | 0 | 98 | 7 | 23 |
| 1997 | 36 | 14 | 0.88 | 0.71 | -0.20 | -1 | 98 | 11 | 23 |
| 1998 | 35 | 15 | 0.89 | 0.71 | -0.13 | 1 | 97 | 4 | 24 |
| 1999 | 33 | 14 | 0.92 | 0.73 | -0.15 | 0 | 106 | 8 | 24 |
| 2000 | 31 | 13 | 0.91 | 0.77 | -0.12 | 3 | 96 | 5 | 24 |

Table 10(e) Global T+72: Verification of the Global Model 72-hour forecast of the geopotential height (in metres) and geostrophic wind (in knots) at 1000 hPa, valid at 00Z.

## TABLE 11: ANNUAL MEAN STATISTICS FOR THE GLOBAL WAVE-MODEL

## VERIFICATION AGAINST OBSERVATIONS

| | MEAN ERROR | | | RMS ERROR | | |
|---|---|---|---|---|---|---|
| | T+24 | T+48 | T+72 | T+24 | T+48 | T+72 |
| 1988 | 1.2 | 1.2 | 1.2 | 6.0 | 7.0 | 7.8 |
| 1989 | 1.2 | 1.2 | 1.2 | 5.8 | 7.0 | 7.8 |
| 1990 | 0.8 | 1.0 | 0.8 | 5.6 | 6.6 | 7.2 |
| 1991 | 1.0 | 1.2 | 1.4 | 5.2 | 6.2 | 7.2 |
| 1992 | 0.4 | 0.8 | 1.0 | 5.1 | 6.0 | 6.8 |
| 1993 | 0.8 | 1.0 | 1.2 | 5.1 | 5.8 | 6.8 |
| 1994 | 0.8 | 1.4 | 1.4 | 5.1 | 6.0 | 6.8 |
| 1995 | 1.0 | 1.2 | 1.2 | 5.1 | 6.0 | 6.8 |
| 1996 | 1.2 | 1.3 | 1.5 | 5.1 | 5.8 | 6.6 |
| 1997 | 1.0 | 1.2 | 1.2 | 4.9 | 5.8 | 6.6 |
| 1998 | 1.4 | 1.6 | 1.6 | 4.9 | 5.6 | 6.4 |
| 1999 | 1.7 | 1.9 | 2.1 | 5.1 | 5.8 | 6.6 |
| 2000 | 1.4 | 1.6 | 1.6 | 5.1 | 5.8 | 6.6 |

Table 11(a) Mean and Rms errors of wind speed forecasts used as input for the Global Wave Model (in knots).

N.B.: Please note that the wind speed statistics for 1999 have been corrected.

| | MEAN ERROR | | | RMS ERROR | | |
|---|---|---|---|---|---|---|
| | T+24 | T+48 | T+72 | T+24 | T+48 | T+72 |
| 1988 | 0.1 | 0.1 | 0.0 | 0.9 | 1.0 | 1.1 |
| 1989 | -0.1 | 0.0 | 0.0 | 0.9 | 1.0 | 1.1 |
| 1990 | -0.1 | -0.1 | -1.0 | 0.8 | 0.9 | 1.1 |
| 1991 | -0.3 | -0.2 | -0.2 | 0.9 | 0.9 | 1.0 |
| 1992 | -0.4 | -0.4 | -0.4 | 1.0 | 1.1 | 1.2 |
| 1993 | -0.2 | -0.2 | -0.2 | 0.8 | 0.9 | 1.0 |
| 1994 | -0.3 | -0.2 | -0.1 | 0.8 | 0.9 | 1.0 |
| 1995 | -0.1 | 0.0 | 0.0 | 0.7 | 0.8 | 0.9 |
| 1996 | 0.1 | 0.1 | 0.1 | 0.6 | 0.8 | 0.9 |
| 1997 | 0.1 | 0.1 | 0.1 | 0.6 | 0.7 | 0.8 |
| 1998 | 0.1 | 0.2 | 0.2 | 0.6 | 0.7 | 0.9 |
| 1999 | 0.2 | 0.2 | 0.2 | 0.6 | 0.7 | 0.9 |
| 2000 | 0.1 | 0.1 | 0.2 | 0.6 | 0.7 | 0.8 |

Table 11(b) Mean and Rms errors of wave height forecasts from the Global Wave Model (in metres)

| | MEAN ERROR | | | RMS ERROR | | |
|---|---|---|---|---|---|---|
| | T+24 | T+48 | T+72 | T+24 | T+48 | T+72 |
| 1988 | -0.7 | -0.6 | -0.7 | 2.4 | 2.6 | 2.8 |
| 1989 | -0.3 | -0.1 | -0.1 | 2.5 | 2.7 | 2.9 |
| 1990 | -0.1 | 0.0 | 0.1 | 2.4 | 2.6 | 2.7 |
| 1991 | *** | *** | *** | *** | *** | *** |
| 1992 | -0.2 | -0.3 | -0.4 | 3.3 | 3.9 | 4.0 |
| 1993 | 0.3 | 0.1 | 0.0 | 2.6 | 2.7 | 2.8 |
| 1994 | 0.3 | 0.1 | 0.1 | 2.6 | 2.7 | 2.8 |
| 1995 | 0.6 | 0.5 | 0.5 | 2.5 | 2.7 | 2.8 |
| 1996 | 0.9 | 0.8 | 0.7 | 2.7 | 2.8 | 2.9 |
| 1997 | 0.9 | 0.8 | 0.7 | 2.6 | 2.7 | 2.8 |
| 1998 | 0.8 | 0.8 | 0.7 | 2.5 | 2.7 | 2.8 |
| 1999 | 0.7 | 0.8 | 0.8 | 2.4 | 2.6 | 2.8 |
| 2000 | 0.6 | 0.8 | 0.9 | 2.7 | 2.9 | 3.1 |

Table 11(c) Mean and Rms errors of wave period forecasts from the Global Wave Model (in seconds).

## TABLE 12: ANNUAL MEAN STATISTICS FOR THE EUROPEAN WAVE-MODEL

## VERIFICATION AGAINST OBSERVATIONS

| | MEAN ERROR | | | RMS ERROR | | |
|---|---|---|---|---|---|---|
| | T+12 | T+24 | T+36 | T+12 | T+24 | T+36 |
| 1988 | 0.8 | 1.0 | 1.0 | 5.2 | 6.0 | 7.0 |
| 1989 | 1.0 | 1.2 | 1.4 | 5.2 | 5.8 | 6.8 |
| 1990 | 1.2 | 1.2 | 1.4 | 5.2 | 5.8 | 6.4 |
| 1991 | 0.8 | 1.2 | 1.6 | 4.9 | 5.4 | 6.2 |
| 1992 | 0.8 | 1.4 | 1.6 | 5.2 | 6.0 | 6.8 |
| 1993 | 0.7 | 1.2 | 1.4 | 5.1 | 5.8 | 6.6 |
| 1994 | 1.4 | 1.6 | 2.1 | 5.1 | 5.8 | 6.6 |
| 1995 | 1.4 | 1.5 | 1.9 | 4.7 | 5.4 | 6.0 |
| 1996 | 1.4 | 1.4 | 1.7 | 4.7 | 5.2 | 5.6 |
| 1997 | 1.4 | 1.2 | 1.7 | 4.5 | 5.2 | 5.6 |
| 1998 | 1.4 | 1.2 | 1.7 | 4.7 | 5.6 | 6.2 |
| 1999 | 1.4 | 1.2 | 1.7 | 5.1 | 5.4 | 6.0 |
| 2000 | 1.2 | 1.2 | 1.4 | 4.5 | 5.1 | 5.6 |

Table 12(a) Mean and Rms errors of wind speed forecasts used as input for the European Wave Model (in knots).

N.B.: Please note that the wind speed statistics for 1999 have been corrected.

| | MEAN ERROR | | | RMS ERROR | | |
|---|---|---|---|---|---|---|
| | T+12 | T+24 | T+36 | T+12 | T+24 | T+36 |
| 1988 | 0.1 | 0.1 | 0.1 | 0.8 | 0.9 | 0.9 |
| 1989 | 0.2 | 0.2 | 0.3 | 0.9 | 0.9 | 1.0 |
| 1990 | 0.0 | 0.0 | 0.0 | 0.9 | 0.9 | 1.0 |
| 1991 | 0.1 | 0.1 | 0.1 | 1.0 | 1.0 | 1.1 |
| 1992 | -0.2 | -0.1 | 0.0 | 0.9 | 0.9 | 1.0 |
| 1993 | -0.2 | -0.2 | -0.1 | 0.9 | 0.9 | 1.0 |
| 1994 | -0.2 | -0.1 | 0.0 | 0.8 | 0.8 | 0.9 |
| 1995 | 0.0 | 0.0 | 0.1 | 0.7 | 0.8 | 0.8 |
| 1996 | 0.1 | 0.1 | 0.2 | 0.6 | 0.7 | 0.7 |
| 1997 | 0.1 | 0.1 | 0.2 | 0.6 | 0.7 | 0.7 |
| 1998 | 0.1 | 0.1 | 0.2 | 0.6 | 0.7 | 0.8 |
| 1999 | 0.1 | 0.1 | 0.1 | 0.7 | 0.7 | 0.7 |
| 2000 | 0.1 | 0.1 | 0.2 | 0.6 | 0.7 | 0.7 |

Table 12(b) Mean and Rms errors of wave height forecasts from the European Wave Model (in metres).

| | MEAN ERROR | | | RMS ERROR | | |
|---|---|---|---|---|---|---|
| | T+12 | T+24 | T+36 | T+12 | T+24 | T+36 |
| 1988 | -0.3 | -0.3 | -0.3 | 1.5 | 1.6 | 1.6 |
| 1989 | -0.1 | 0.0 | 0.0 | 1.6 | 1.6 | 1.7 |
| 1990 | -0.2 | -0.2 | -0.2 | 1.3 | 1.3 | 1.4 |
| 1991 | -0.3 | -0.3 | -0.2 | 1.6 | 1.6 | 1.6 |
| 1992 | -0.4 | -0.3 | -0.2 | 1.9 | 1.9 | 1.9 |
| 1993 | -0.4 | -0.3 | -0.3 | 1.9 | 1.9 | 2.0 |
| 1994 | 0.0 | 0.0 | 0.0 | 1.1 | 1.4 | 1.5 |
| 1995 | -0.6 | -0.5 | -0.5 | 1.6 | 2.0 | 2.0 |
| 1996 | -0.4 | -0.3 | -0.3 | 1.4 | 1.5 | 1.5 |
| 1997 | -0.2 | -0.2 | -0.2 | 1.3 | 1.3 | 1.3 |
| 1998 | -0.3 | -0.2 | -0.3 | 1.3 | 1.3 | 1.3 |
| 1999 | -0.5 | -0.3 | -0.5 | 1.4 | 1.4 | 1.4 |
| 2000 | -0.7 | -0.6 | -0.7 | 1.5 | 1.5 | 1.5 |

Table 12(c) Mean and Rms errors of wave period forecasts from the European Wave Model (in seconds).

TABLE 13: VERIFICATION OF LONDON PRECIPITATION FORECAST

| | RAIN FORECAST | NO RAIN FORECAST | ALL CASES |
|---|---|---|---|
| 1962 | 63 | 81 | 73 |
| 1963 | 71 | 72 | 72 |
| 1964 | 68 | 79 | 72 |
| 1965 | 69 | 76 | 72 |
| 1966 | 77 | 74 | 75 |
| 1967 | 73 | 74 | 75 |
| 1968 | 70 | 79 | 75 |
| 1969 | 71 | 78 | 75 |
| 1970 | 64 | 74 | 70 |
| 1971 | 63 | 82 | 76 |
| 1972 | 70 | 78 | 75 |
| 1973 | 67 | 80 | 76 |
| 1974 | 74 | 76 | 75 |
| 1975 | 68 | 85 | 77 |
| 1976 | 67 | 84 | 78 |
| 1977 | 71 | 79 | 75 |
| 1978 | 73 | 84 | 79 |
| 1979 | 72 | 78 | 75 |
| 1980 | 67 | 83 | 76 |
| 1981 | 70 | 87 | 76 |
| 1982 | 73 | 87 | 81 |
| 1983 | 73 | 86 | 80 |
| 1984 | 74 | 89 | 83 |
| 1985 | 72 | 85 | 79 |
| 1986 | 79 | 80 | 80 |
| 1987 | 78 | 77 | 78 |
| 1988 | 67 | 89 | 81 |
| 1989 | 76 | 84 | 82 |
| 1900 | 74 | 83 | 80 |
| 1991 | 69 | 82 | 77 |
| 1992 | 74 | 84 | 80 |
| 1993 | 74 | 90 | 83 |
| 1994 | 74 | 86 | 81 |
| 1995 | 75 | 90 | 84 |
| 1996 | 67 | 85 | 77 |
| 1997 | 69 | 85 | 79 |
| 1998 | 70 | 88 | 80 |
| 1999 | 66 | 90 | 80 |
| 2000 | 64 | 90 | 78 |

Table 13(a) Percentage of NMC forecasts correct. (Also see graph in Figure 10a)

N.B.: Please note that, from 1998, instead of using both Heathrow and Gatwick for this scheme, only Heathrow is used.

| | RAIN FORECAST | NO RAIN FORECAST | ALL CASES |
|---|---|---|---|
| 1984 | 58 | 86 | 74 |
| 1985 | 77 | 76 | 77 |
| 1986 | 78 | 73 | 75 |
| 1987 | 78 | 61 | 70 |
| 1988 | ** | ** | ** |
| 1989 | 74 | 82 | 80 |
| 1990 | 73 | 81 | 79 |
| 1991 | 67 | 79 | 75 |
| 1992 | 65 | 82 | 74 |
| 1993 | 65 | 91 | 78 |
| 1994 | 65 | 89 | 75 |
| 1995 | 71 | 93 | 83 |
| 1996 | 60 | 89 | 74 |
| 1997 | 56 | 89 | 71 |
| 1998 | 63 | 90 | 75 |
| 1999 | 60 | 92 | 76 |
| 2000 | 58 | 88 | 72 |

Table 13(b) Percentage of Limited Area Model forecasts correct (Also see graph in Figure 10b)

N.B.: Please note that, from 1998, instead of using both Heathrow and Gatwick for this scheme, only Heathrow is used.

FIGURE 3. VERIFICATION AGAINST OBSERVATIONS – AREA 2

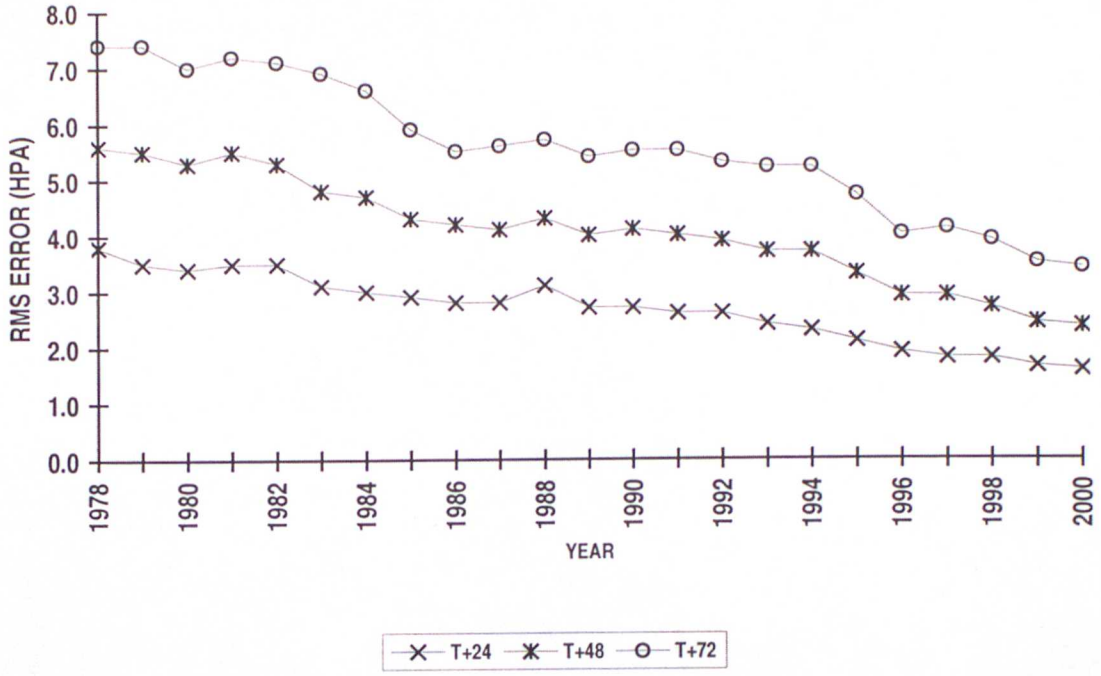


Figure 3(a) Rms error of PMSL

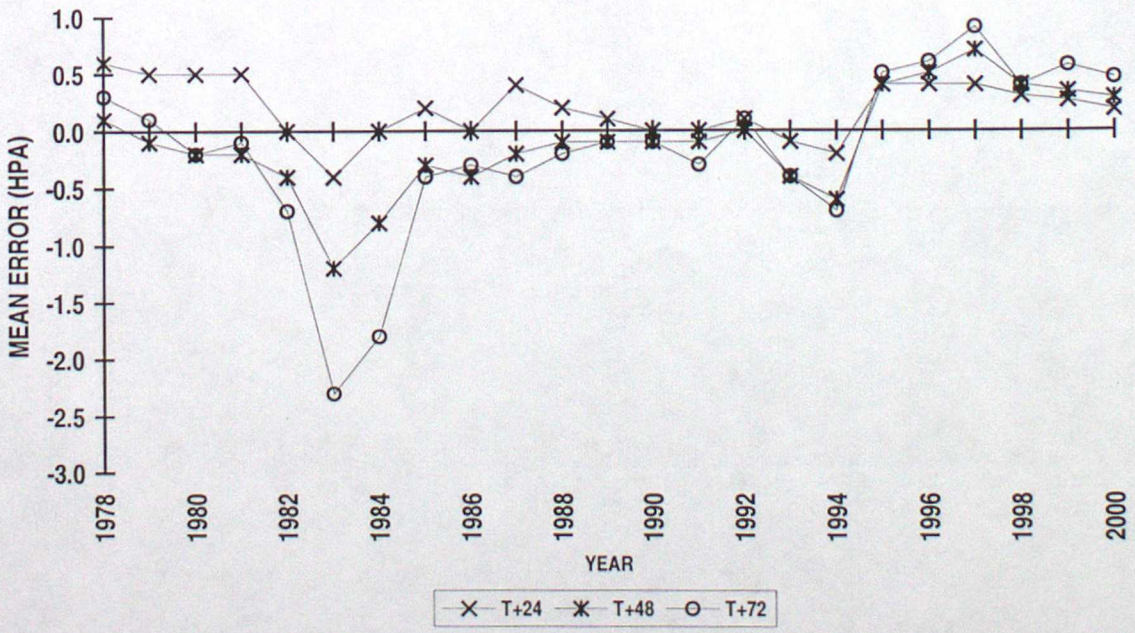


Figure 3(b) Mean error of PMSL

FIGURE 4. VERIFICATION AGAINST ANALYSES – AREA 2

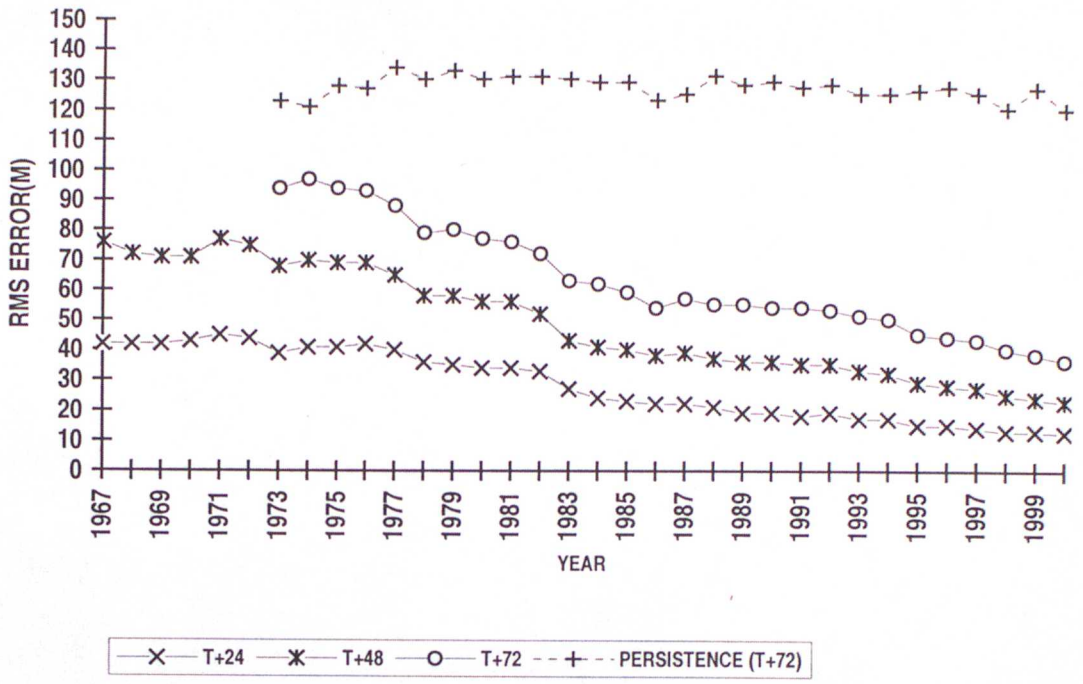


Figure 4(a) Rms error of 500 hPa height

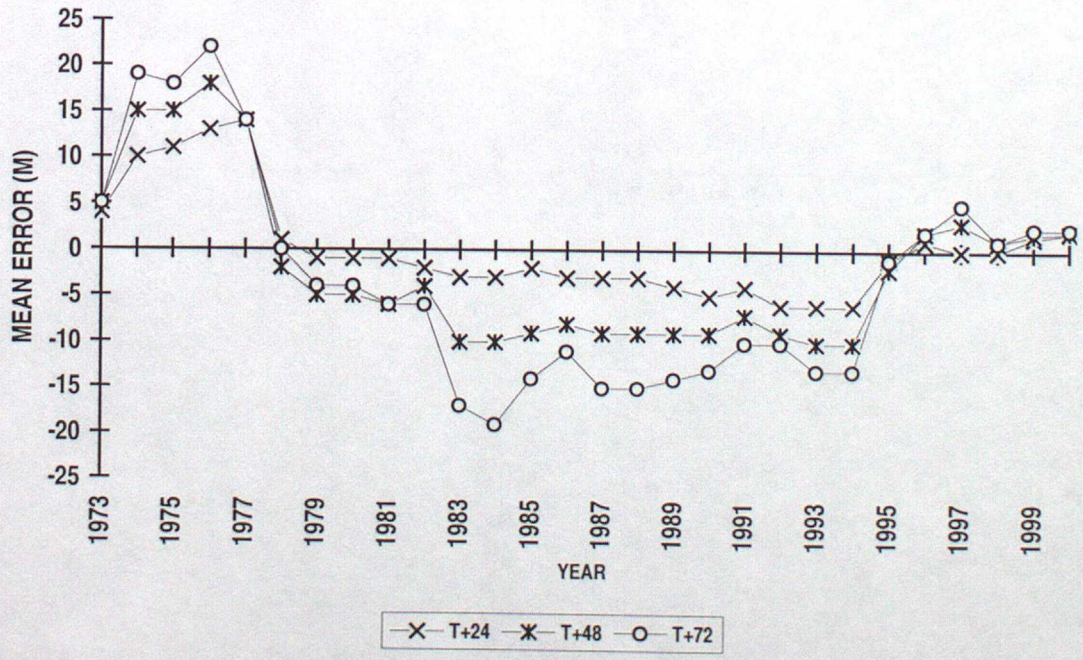


Figure 4(b) Mean error of 500 hPa height

FIGURE 5. VERIFICATION AGAINST ANALYSES – AREA 2

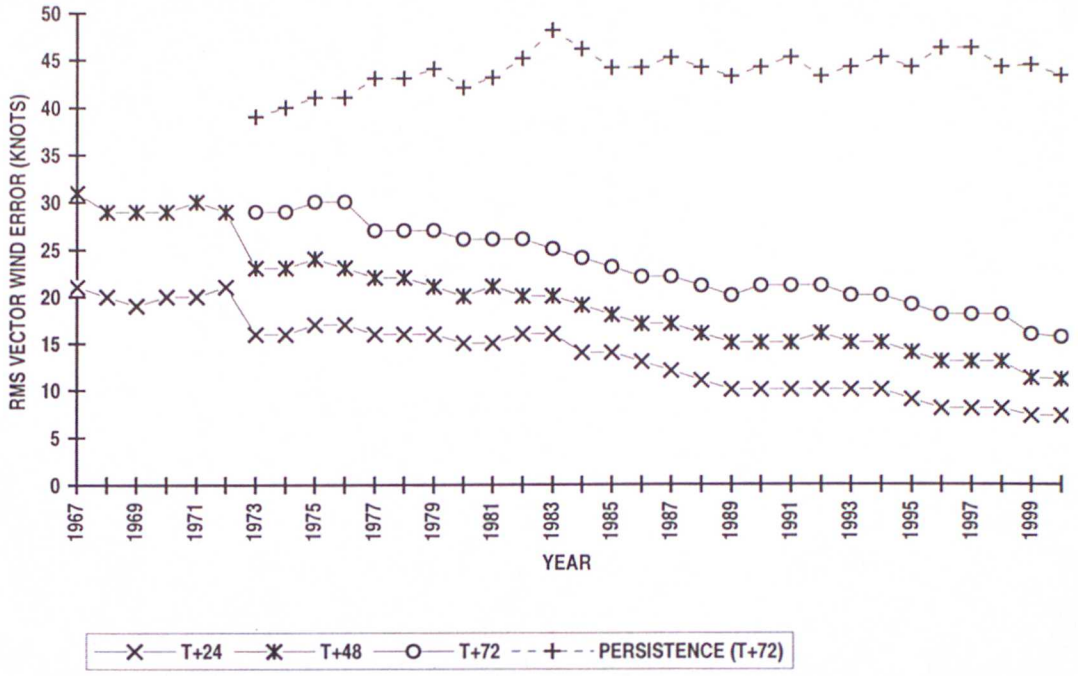


Figure 5(a) Rms vector wind error at 200 hPa

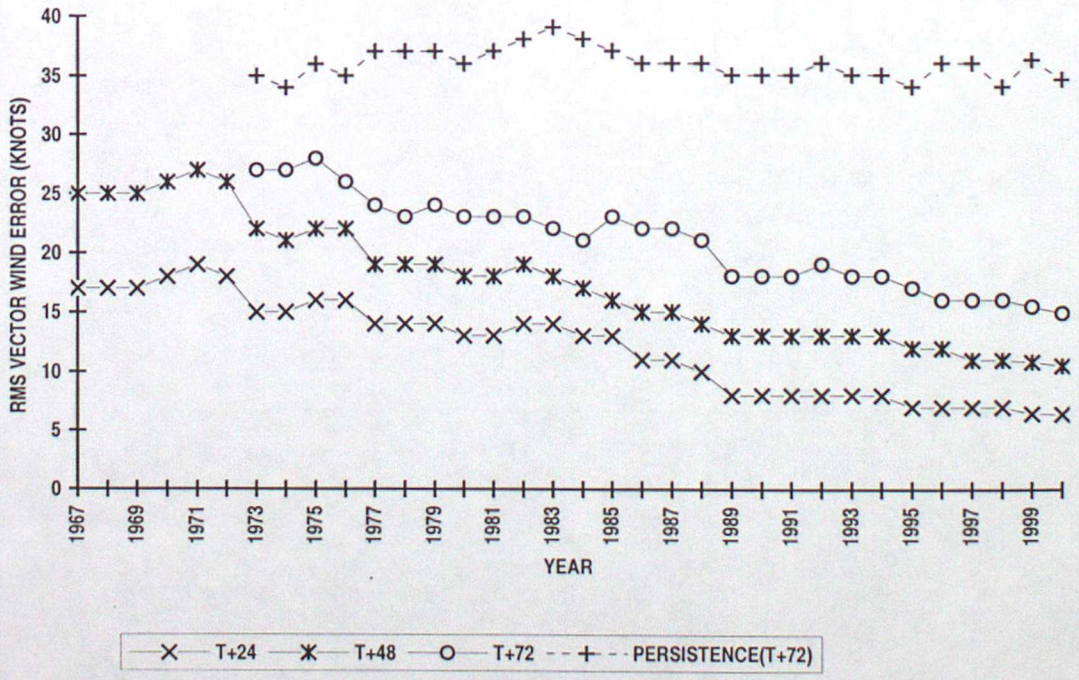


Figure 5(b) Rms vector wind error at 500 hPa

FIGURE 6. VERIFICATION AGAINST ANALYSES – NORTHERN HEMISPHERE

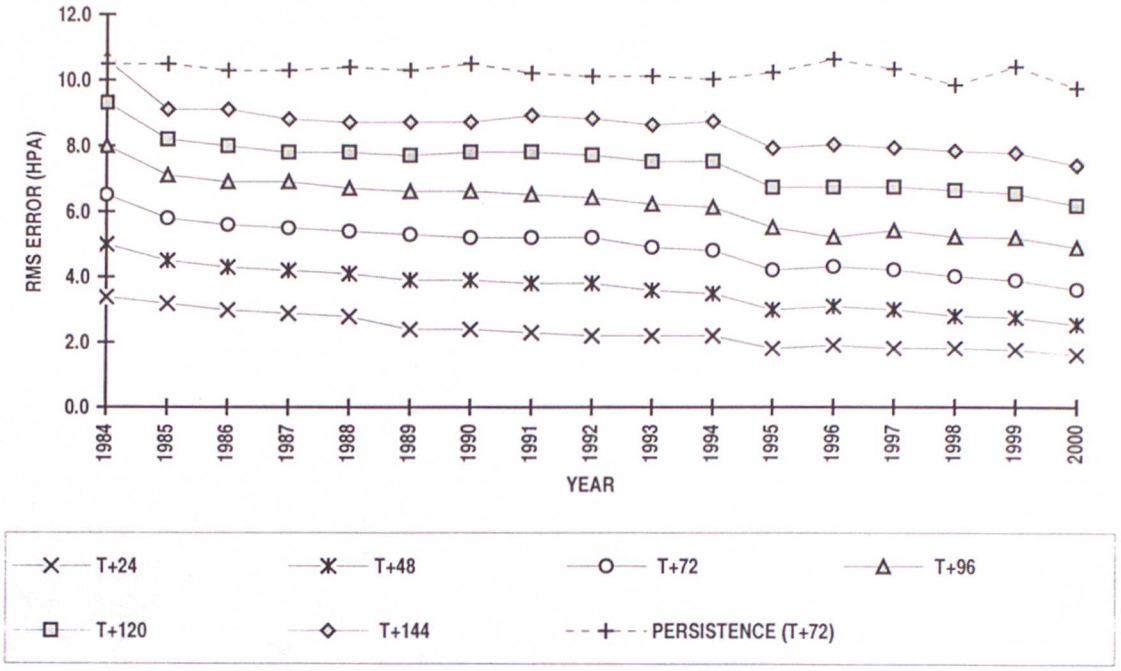


Figure 6(a) Rms error of PMSL

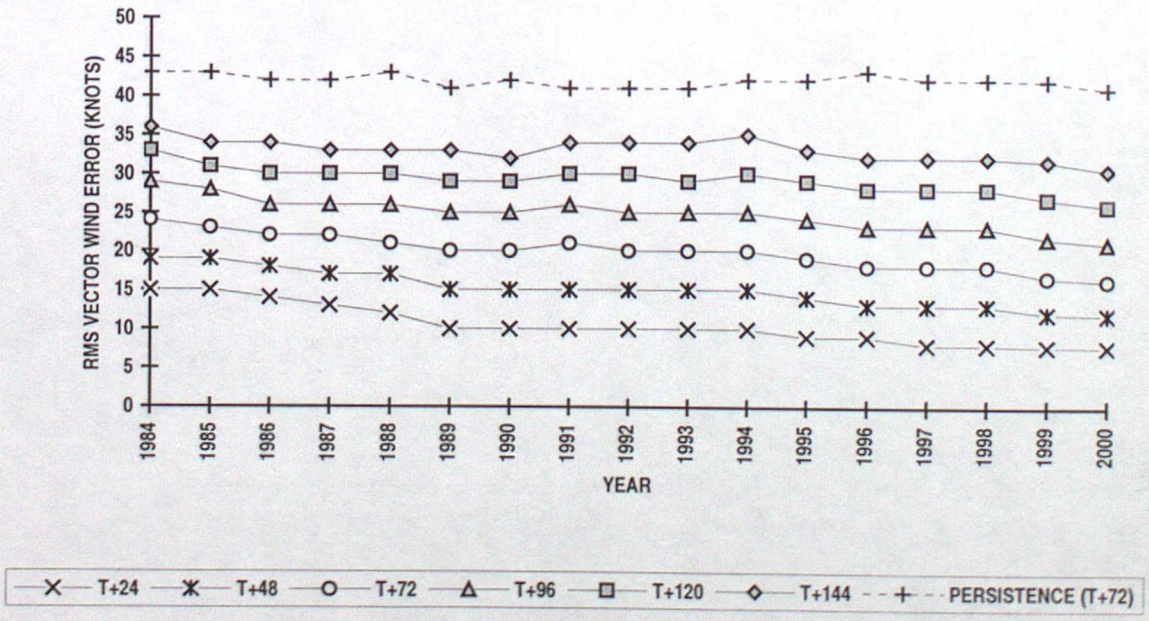


Figure 6(b) Rms vector wind error at 200 hPa

# FIGURE 7 VERIFICATION AGAINST ANALYSES – TROPICS

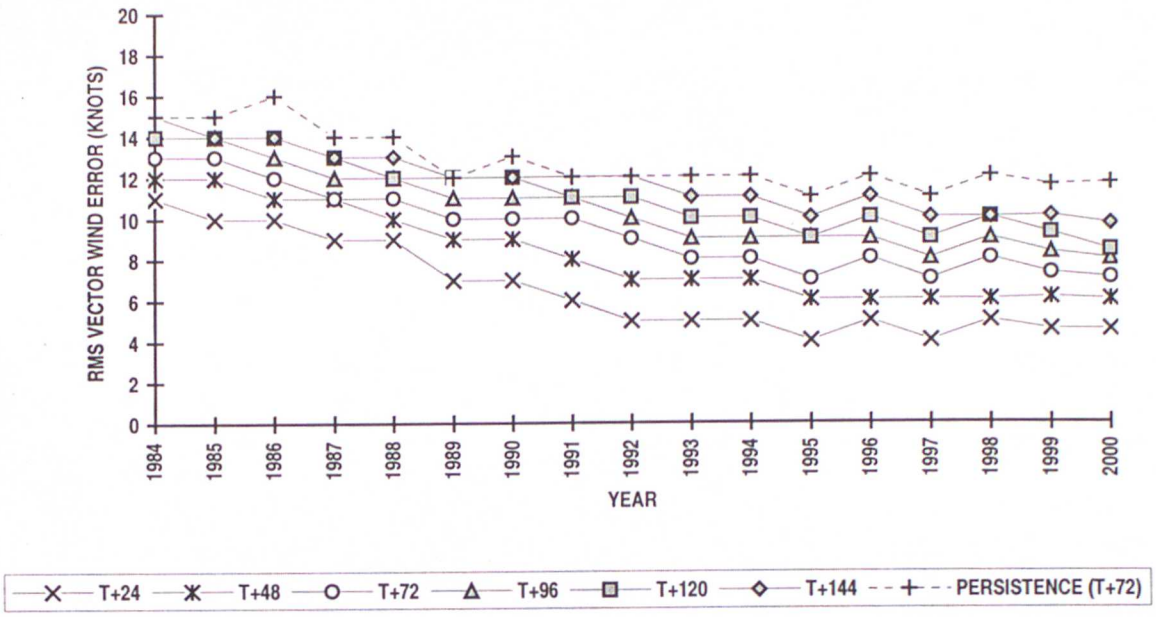


Figure 7(a) Rms vector wind error at 850 hPa

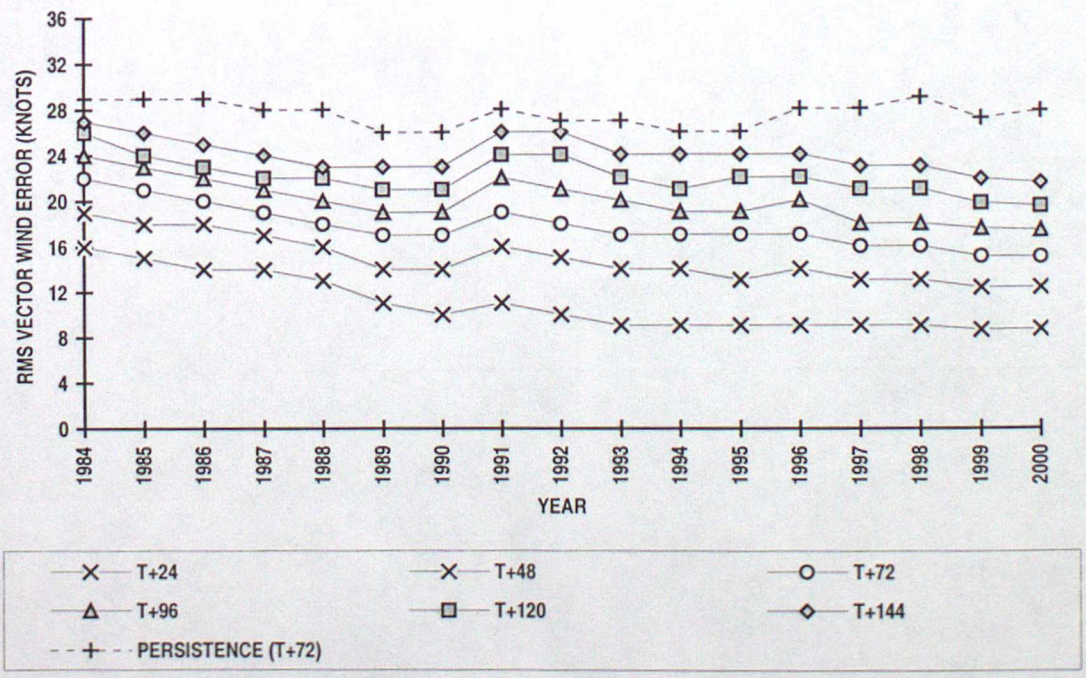


Figure 7(b) Rms vector wind error at 200 hPa

## FIGURE 8 VERIFICATION AGAINST ANALYSES – SOUTHERN HEMISPHERE

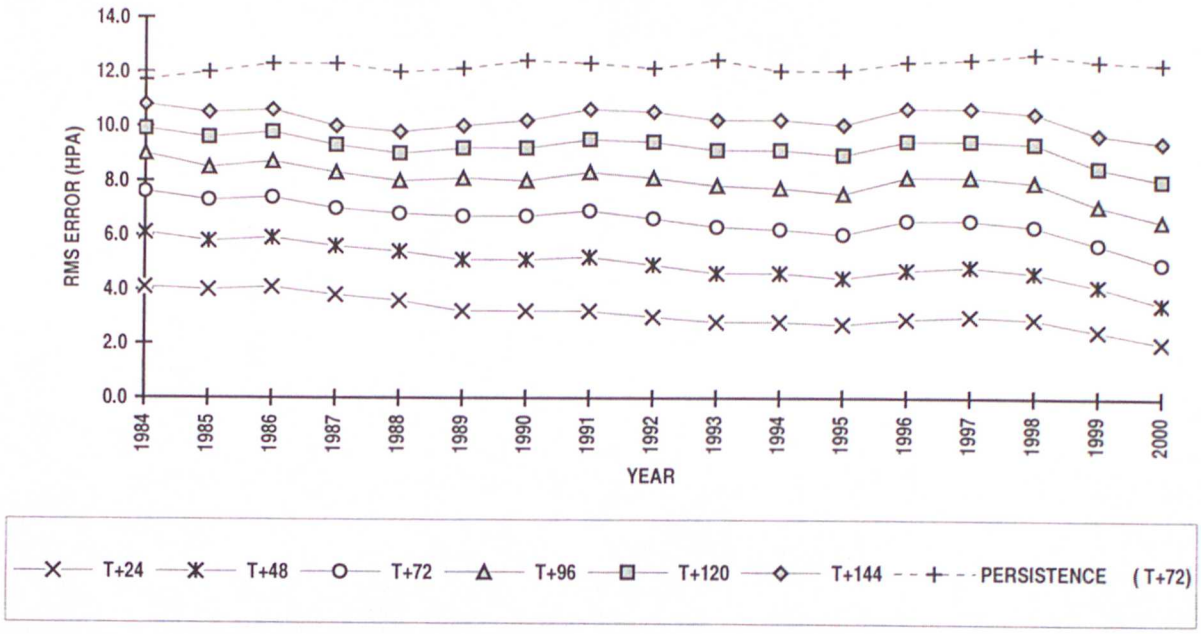


Figure 8(a) Rms error of PMSL

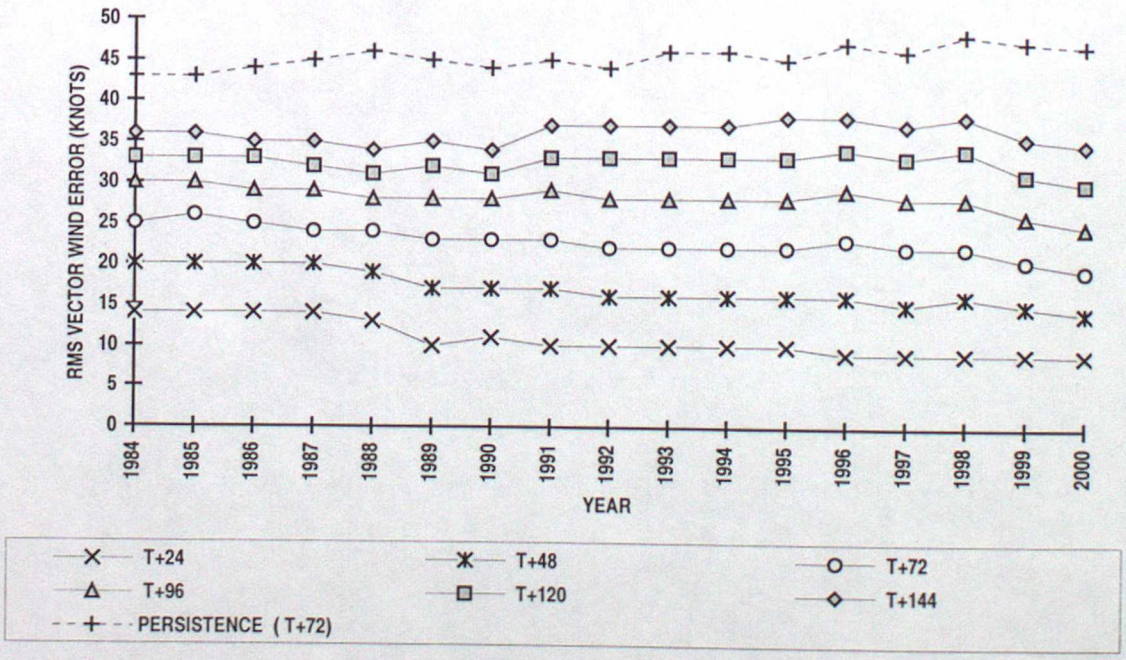


Figure 8(b) Rms vector wind error at 200 hPa

FIGURE 9 48-POINT VERIFICATION SCHEME

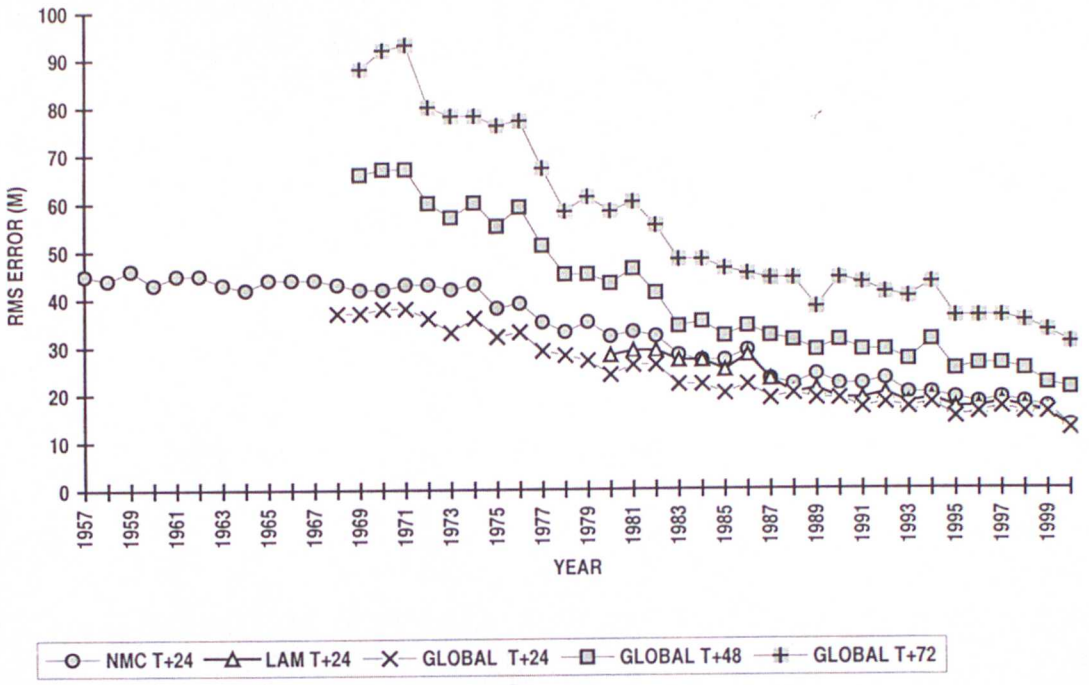


Figure 9(a) Rms error of 1000 hPa height

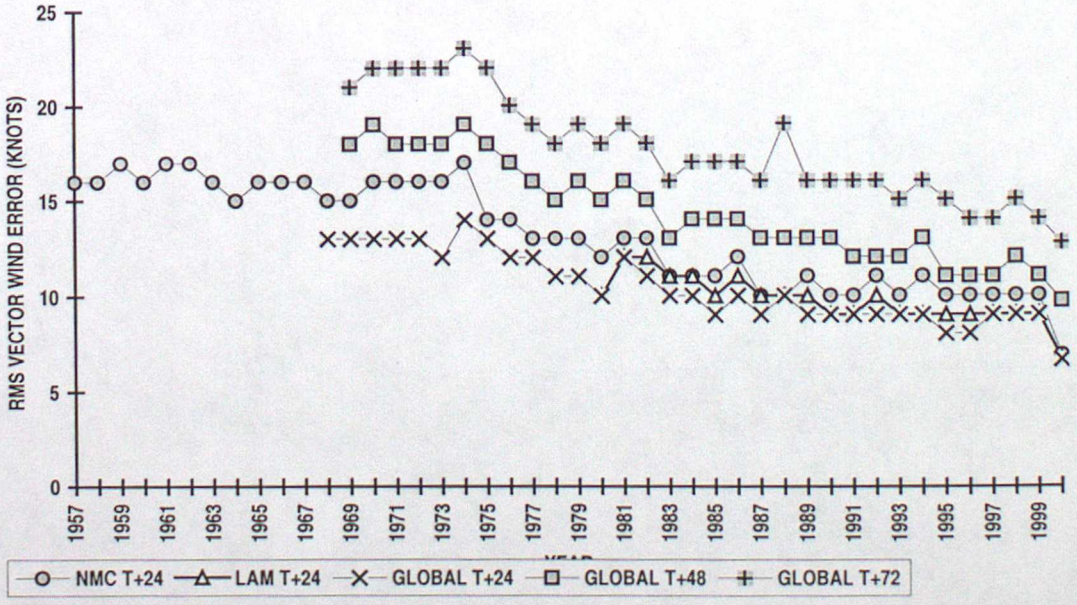


Figure 9(b) Rms vector wind error at 1000 hPa

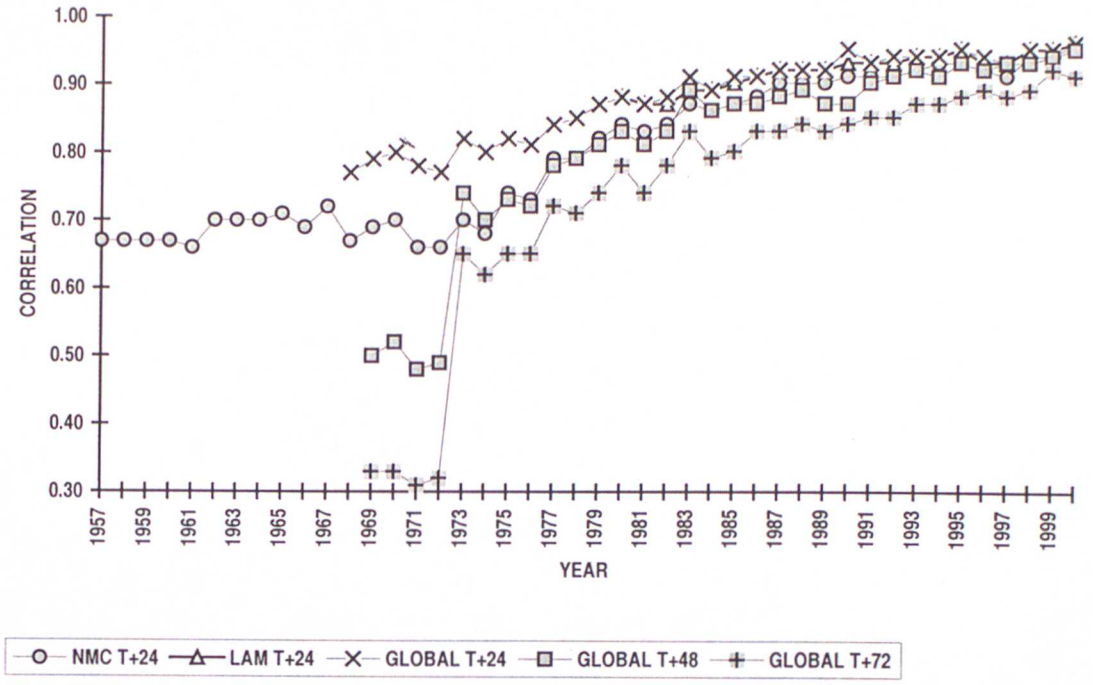


Figure 9(c) Height change correlation at 1000 hPa

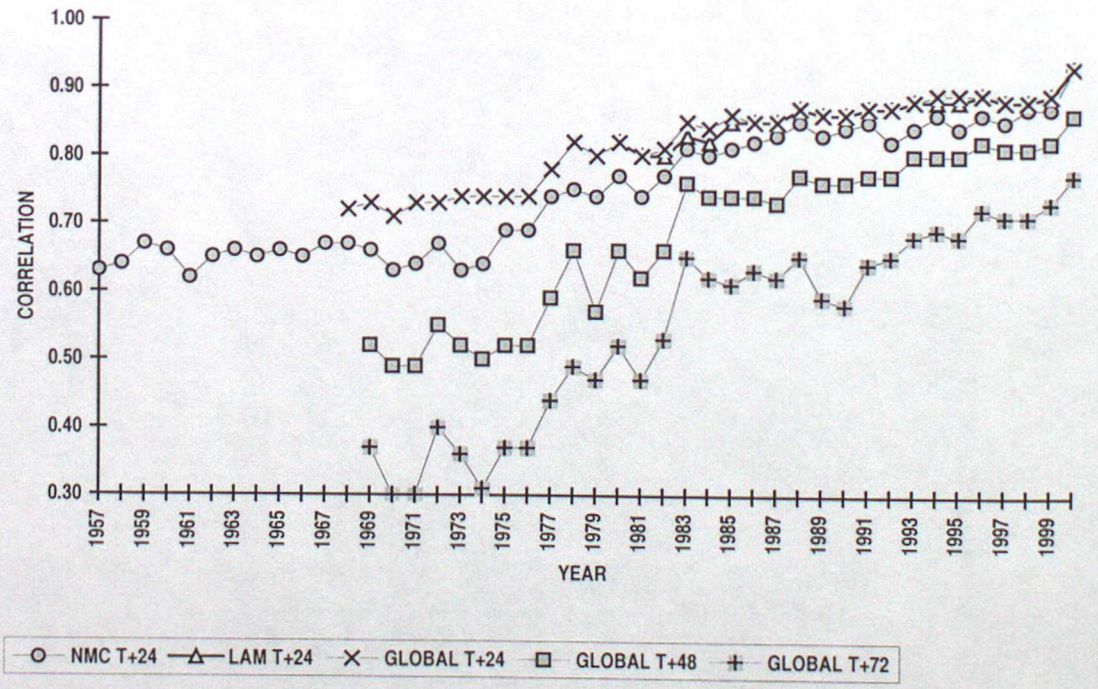


Figure 9(d) Wind stretch vector correlation at 1000 hPa

FIGURE 10 VERIFICATION OF LONDON PRECIPITATION FORECAST

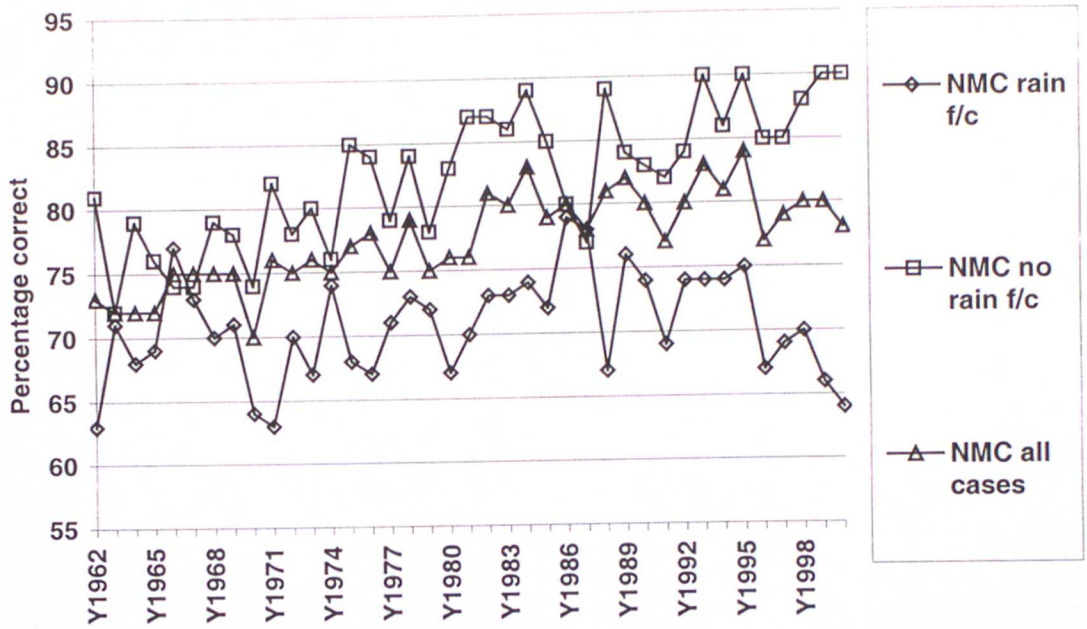


Figure 10(a) Percentage correct of CFO/NMC Precipitation forecasts

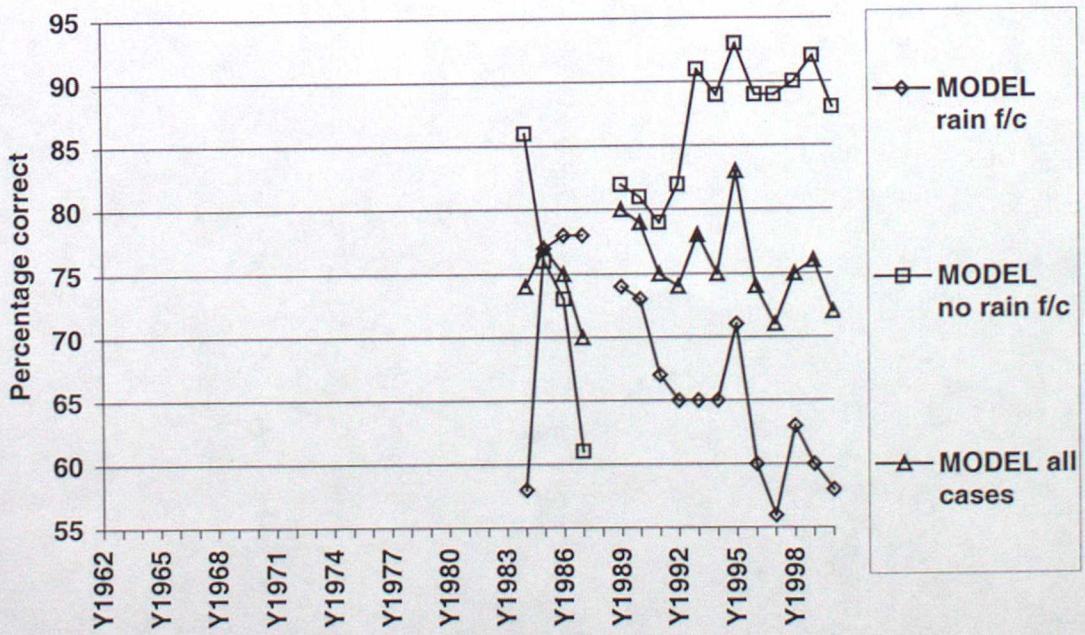


Figure 10(b) Percentage correct of FM/LAM/PRELIM model Precipitation forecasts